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REVUE ALGOLOGIQUE

— FONDÉE EN 1922 —

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SOMMAIRE

E. A. George. — The Cambridge culture collection of Algae and Protozoa 151

K. C. Fan. — Revision of *Calothrix* Ag. 154

F. T. Walker. — The *Laminaria* cycle 179

M. R. Droop. — *Haematococcus pluvialis* and its Allies. II : Nomenclature in *Haematococcus* 182

Notules Algologiques

M. Serpette. — Cellules basales atypiques chez les Cyanophycées sans hétérocystes 193

C. den Hartog. — Deux stations d'*Hildenbrandia rivularis* en Bretagne 194

B. Fott. —Les Flagellés des eaux extrêmement acides 196

Bibliographie 197

BIBL. DU MUSEUM D'HIST. NATURE

The Cambridge Culture Collection of Algae and Protozoa

by E. A. GEORGE
The culture collection of Algae and Protozoa
The Botany School, Downing St., Cambridge, England.

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The early history of this collection was recorded by its founder and former curator, Professor E. G. PRINGSHEIM (1951). Since then the number of cultures has increased from just over four hundred to about nine hundred and a new culture house has been built.

A summary of the strains now in the collection is shown in the table. During 1954, 1,923 cultures were despatched for teaching,

Group	number of genera	number of genera	Group	number of strains	number of genera
Volvocales	168	29	Dinophyceae	10	6
Chlorococcales	207	40	Cryptophyceae	11	5
Ulotrichales	34	9	Chloromonadineae	1	1
Chaetophorales	51	17	Euglenineae	146	14
Cladophorales	4	2	Rhodophyceae	3	1
Oedogoniales	2	1	Myxophyceae	63	30
Conjugales	50	16	Sarcodina	5	2
Siphonales	9	2	Ciliata	19	7
Charales	2	2	Musci	33	11
Xanthophyceae	50	21	Hepaticae	5	4
Chrysophyceae	24	16			
Diatoms	11	3	Totals	908	239

List of major groups maintained with numbers of strains in each and numbers of genera represented. Data for 1954.

research and industrial purposes to 19 different countries. Large numbers have also been sent to daughter collections in the universities of Indiana, Georgia and Göttingen.

Most of the strains are kept as pure cultures on agar slopes and are stored in glass jars (phot. 1). Of the cultures in liquid media a few are bacteria free, but most are only unispecific cultures in biphasic soil and water media. These are in test tubes hung on wires (phot. 2). Non-photosynthetic cultures are stored in card-

board containers (phot. 3). The total number of tubes which can be housed is over 6,000. Other cultures in larger vessels provide material for demonstration purposes.

Many of the cultures are taxonomic type strains or strains which have been used for important research purposes. It is urged that workers always deposit such strains with at least one permanent culture collection to ensure their preservation.

The culture house designed specially for the maintenance of the collection was built in 1953. The walls and roof are of materials giving maximum insulation. The windows are of double glass with an air space between the panes. The flat roof is flooded with water in the warmer months.

Basic heating is by a hot water radiator. A thermostat controls electric tubular heating below the windows (phot. 1 and 2). An extrator fan (phot. 3) draws in fresh air through ventilators above the windows. This fan cane be controlled by a direct switch or through two thermostats, one inside and one outside the room so that it operates only when the temperature inside is above and that outside below a given value. The thermograph has shown this arrangement to work well in the Cambridge climate and the temperature is held between 13° and 18° C..

North daylight from the windows is supplemented as required by fluorescent light (warm white) controlled by a time switch. At present the lighting is used to extend the winter daylight period to twelve hours. In summer the windows are white-washed to reduce the direct insolation from the morning and evening sun.

A work bench (phot. 4) is supplied with water and electricity but coal gas is excluded from the culture house. An efficient spirit burner is available for sterilising purposes.

REFERENCE

Pringsheim E. G. — Die Sammlüng von Algen -, Flagellaten -, und Mooskulturen am Botanischen Institut der Universität Cambridge (*Archiv für Mikrobiologie 16*, 1-17 (1951).

The Algal Culture House at Cambridge.

Revision of *Calothrix* Ag.

by Kung Chu FAN

■

DELINEATION OF SPECIES

The genus *Calothrix* was described by Agardh (1) in 1824 to hold some of the species treated here and also a number of species now placed in other genera. Bornet and Flahault (3), in revising the Rivulariaceae in 1886, recognized twenty-three species of this genus as represented among their large accumulation of specimens from all parts of the world. They found that the numerous species described since 1824 were synonyms of these or growth-forms of other algae. Now, in 1955, after many thousands more specimens have been assembled in herbaria, after so many additional new species have been described by recent authors, and after so much physiological, cytological, and ecological work has been done, it has seemed appropriate that a new revision of the entire family be begun.

In the part of this project now completed, about four thousand herbarium specimens of *Calothrix* from many parts of the world were studied; and field observations were made on certain fresh-water species. It has been found that there are only six autonomous species in the genus. Other species treated in the literature prove to be growth-forms of these six species or of species of other genera. A diagnosis in Latin and a brief morphological description of each species are given here. Problems of nomenclature have been reserved for future study.

The present work was done under the guidance of Dr Francis Drouet, Curator of Cryptogamic Herbarium, Chicago Natural History Museum. I am grateful for his assistance and many suggestions during the course of this research. Thanks also are due to Dr Charles E. Olmsted, Dr Paul D. Voth, Miss Alice Middleton, Mrs. Effie M. Schugman, and M. Clark H. Brown for various kindnesses; and to the Department of Botany, University of Chicago, for the aid of the Wychwood and Robert Ridgway Memorial Fellowships.

MORPHOLOGY

The species of *Calothrix* have multicellular, whip-shaped trichomes enclosed in gelatinous sheaths. The trichome is composed

Source: MNHN Paris

of a single row of usually cylindrical cells which divide at right angles to their axes. It is broad at one end and gradually reduced in diameter toward the other end. In *C. pilosa,* the attenuation is not obvious except in the young stages. The broader end is called the base. The vegetative cells at the base and in certain other parts of the trichome may become thick-walled; these are heterocysts. The terminal end of the trichome usually is attenuated into a colorless, multicellular hair-like portion. The trichome and its enclosing sheath comprise the filament.

The cell is a mass of protoplasm without a definite nucleus; it is enclosed by a thin, firm layer, the cell membrane. The protoplasm is colored blue-green, yellow-brownish, or purplish. It contains granules of various sizes and shapes. The cells of the hair usually contain large vacuoles, which are not conspicuous in other healthy vegetative cells. The protoplasm is reported (9, 22) as consisting of an inner centroplasm and of an outer layer of chromatoplasm in which the pigments (chlorophyll, carotene, xanthophyll, phycocyanin, and phycoerythrin, the green, orange, yellow, blue, and red pigments, respectively) (2, 7, 11, 13, 14, 15, 21, 25) and granules (glycoproteins and other proteins and carbonhydrates) (16, 18, 19, 22) are included. Cell division is by the process of fission, during which the cell constricts and pinches in half or a membrane grows centripetally through the middle of the cell toward its center (17). All cells appear to be capable of division. At the base of the hair, the daughter cells during and after division elongate and shrink in diameter, develop large vacuoles, and lose much of their color.

Any vegetative cell may enlarge and differentiate as a heterocyst. A thick wall is secreted outside the membrane, and a granule-like thickening is formed in the middle of each end wall adjacent to a vegetative cell; the protoplasm becomes homogeneous, and its color often gradually disappears. The granule-like thickenings of the end walls are reported (9) as surrounding or replacing the protoplasmic strands which connect with the adjacent cells. Basal heterocysts are hemispherical or obovoid; since they do not secrete sheath material after they become mature, they may or may not be enclosed within the main structure of the sheath. The intercalary heterocysts are usually cylindrical in shape; they are as a rule firmly attached to the sheath. Germination of the heterocyst in the Nostocaceae has been reported by various authors (8, 24) and in *Calothrix* by STEINECKE (23).

The vegetative cells secrete gelatinous material, chiefly pectic substances and celluloses (16), through the cell membrane; this accumulates as a cylindrical sheath surrounding the trichome. The

Source: MNHN Paris

sheath is at first hyaline and homogeneous. Later, as successive layers of gelatinous material are secreted, it may become very thick and lamellated, especially in the terminal portion. This feature is quite often seen in terrestrial plants. The outer surfaces of the sheath may be smooth or rough; and though considerable hydrolysis may take place, the sheath of one filament never coalesces with that of another as in species of *Rivularia* and *Gloeotrichia*. It may e colorless, blue-greenish, yellow-brownish, or violet. The yellow and brown pigments are fuscochlorin and fuscorhodin (16); the violet or blue pigment is gloeocapsin (12). The color, consistency, and structure must vary according to the history of the micro-environment during and since the formation of the sheath.

Fungus hyphae are often seen in the sheaths; they may be responsible for changes in color and consistency of the gelatinous material. The hyphae of certain fungi parasitize the cells. The cells or trichomes usually die as the result of such parasitization, or with the fungus the alga continues to grow as a lichen (5, 6, 10).

Fragmentation is the only method of multiplication. Within a trichome a cell dies and is pressed into a biconcave shape by the two neighboring cells; the trichome becomes separated into two pieces when tbis dead cell disintegrates. The death of cells and the resultant breaking of the trichomes are effected in nature by such mechanical actions and physiological changes as take in the splashing of waves, the flowing of water, repeated wetting and drying, freezing, overheating, changes in salinity, parasitization by fungi, and depredation by fish or other animals. Fragments of trichomes are called hormogonia. Hormogonia move out of the broken sheath, or from the open terminal portion of the sheath, and regenerate into mature trichomes and filaments. Hormognia may also remain and grow within the sheath, especially where intercalary heterocysts prevent their movement out of the sheath; during elongation they burst out through the sides of the sheath. In this manner, branches of the filament may be produced. Forms of branching will be described under each species.

HABITATS

The filaments of all species of *Calothrix* are decumbent and interwoven or parallel on substrata; or they grow in an erect or stellate fashion, attached by he basal parts only. They are fonnd on pebbles, shells, rocks, soil, tree trunks, basins of drinking fountains, walls of shower rooms, concrete work, and pilings. Also they may be epiphytic on or endophytic in various aquatic plants. Species of this genus are widely spread all over the world and grow within a wide

MNHN Paris

range of habitats. The specimens examined are from aquatic, subaerial, and aerial habitats, from fresh-water and saline marshes to the intertidal zones of the oceans, from swamps, ditches, and lakes with standing water to creeks or falls where water runs very fast, from arctic to tropic zones, from cold to thermal springs. In the last, the highest temperature that is recorded (20) for a species of this genus is 62.5°C. COPELAND (4) mentionned that *Calothrix* is usually associated with diatoms in the basic, neutral, and slightly acid springs and absent in extremly acid springs.

THE SPECIES

The nomenclature employed here is that of BONET and FLAHAULT (3). The specimens listed are all on file in the Cryptogamic Herbarium, Chicago Natural History Museum, except where indicated by the following abbreviations as occurring in other herbaria : D, herbarium of Francis DROUET; FA, herbarium of KUNG CHU FAN.

Key to the species of *Calothrix* :

1. Heterocysts none, basal portion of sheath thickened *C. Juliana.*
1. Heterocysts present, basal portion of sheath usually not thickened 2
2. Marine, attenuation from basal to terminal portions of the trichome not obvious ..... *C. pilosa.*
2. Marine or fresh-water, the attenuation from basal to terminal portion of the trichome obvious 3
3. Fresh-water 4
3. Marine 5
4. Cells as long as broad or shorter in the middle of the trichome, sheath not thickened in the basal portion *C. parietina.*
4. Cells 3-4 times shorter than broad in the middle portion of the trichome, basal part of the sheath usually thickened ..... *C. adscendens.*
5. Cells at the middle portion of the trichome usually 2-4 times shorter than the diameter, discoid in shape 6
5. Cells at the midde portion of the trichome usually as long as broad or a little shorter ..... *C. parietina.*
6. Intercalary heterocysts absent, filament unbranched .... *C. confervicola.*
6. Intercalary heterocysts present, filament branched or unbranched ..... *C. crustacea.*

CALOTHRIX JULIANA (Meneghini) Bornet et Flahault.

Fila sparsa vel densius approximata, erecta vel decumbentia intricata, simplicia, in pilum longissimum attenuata, ad 2 mm. longa, 8-30 μ crassa, vugina arcta, achroa, praecipuius homogenea, trichomatibus saepissime purpureis, and basem saepe incrassatis bulboso-inflatis; articulis diametro triplo brevioribus; heterocystis nullis. Fig. 4.

C. juliana is the only species in which the trichomes lack basal heterocysts. When a hormogonium begins to regenerate, a homogeneous sheath is secreted which becomes gradually thickened at the basal portion where the filament is attached to the substratum. The trichome, as it elongates, gradually becomes reduced in diameter toward the apex, and it may or may not develop a hair at its upper end. The filaments grow erect on such substrata as stones and aquatic plants. Like those of *C. parietina*, the filaments can grow in the gelatinous fronds of *Batrachospermum;* but they are usually smaller and shorter in this habitat than those which grow on other substrata.

Specimens studied : **France** : prope Montpellier, C. Flahault, Oct. 21, 1892 (as *Calothrix juliana* in Wittr., Nordst. et Lagerh., Alg. Exs. 1305). **New Hampshire** : Lake Chocorua, F. S. Collins, Sept. 16, 1906 (as *C. fusca* in Coll., Hold. et Setch., Phyc. Bor.-Amer. 1407); Washburn Corners, Enfield, L. H. Flint, Aug. 19, 1945. **Vermont** : Morrisville, Flint June 21, 1945. **Connecticut** : Norwich, W. A. Setchell, Sept. 5, 1892 (as *C. juliana* in Coll., Hold. et Setch., Phyc. Bor.-Amer. 113), Setchell *530*, Sept. 6, 1892; Bridgeport L. N. Johnson 812, July 27, 1892. **Pennsylvania** : F. Wolle coll. (D); North Warren, T. Flanagan *23*, July 1, 1943. **Virginia** : Poverty Creek Valley, Craig county, J. C. Strickland, July 30, 1938. **Florida** : Aspalaga, Liberty county, C. S. Nielsen, G. C. Madsen & D. Crowson *742*, Feb. 12, 1949; Rainbow Springs, Dunnellon, M. A. Brannon *378*, Oct. 20, 1946. **Alabama** : Tuscaloosa, R. L. Caylor 2, 3, Jan. 8, 10, 1945. **Michigan** : Ann Arbor, L. N. Johnson *1021*, Nov. 11, 1893; Douglas Lake, Cheboygan county, H. K. Phinney *27M39-1*, July 27, 1939. **Indiana** : Richmond, L. J. King *126*, 1940. **Mississippi** : Sandy Hook, Flint, Dec. 4, 1948. **Missouri** : Gravois Mills, F. Drouet *681*, Sept. 7, 1930 (D); Iberia, C. Shoop *47*, Sept. 19, 1938; Zora, Benton county, Shoop *133*, Sept. 24, 1938. **Nebraska** : Rock Creek Lake state park, Dundy county, W. Kiener *19817*, Oct. 5, 1945. **Arizona** : Havasupai canyon, Coconino county, E. U. Clover, Aug. 1, 1940. **Californio** : Pasadena, A. J. McClatchie, Jan. 27, 1896 (as. *C. juliana* in Tild., Amer. Alg. 163). **Puerto Rico** : Fajardo, N. Wille 684a, Jan. 26, 1915. **Mexico** : Santa Catarina, F. A. Barkley *14608b*, Aug. 16, 1944; 5 miles north of Monterey, Barkley *14622*, *14623*, Aug. 18, 1944. **Guatemala** : Lake Amatitlan, W. A. Kellerman *5061*, Jan. 28, 1906 (as *Lyngbya martensiana* in Tild.,

Source : MNHN Paris

Amer. Alg. 637); La Laguna, dept. Alta Verapaz, J. A. STEYERMARK *46379*, May 10, 1942.

CALOTHRIX PARIETINA (Nägeli) Thuret.

Stratum crustaceum, caespitosum, vel mucosum, filis erectis seu decumbentibus, dense stipatis, parallelis, flexuosis, vel intricatis, ad 3 mm. longis, 7-15 μ crassis; ramis in modum Scytonematum vel Tolypothrichum egredientibus; vagina tenue vel crassiuscula, arcta vel lamellosa, achroa, luteo-fusca, vel aeruginea; trichomatibus luteo-fuscis, aerugineis, vel olivaceo-viridibus, 4-12 μ crassis; articulis diametro aequalibus vel paullo brevioribus, torulosis vel cylindraceis; heterocystis basilaribus et intercalaribus. Fig. 1 .

C. parietina grows in many different habitats : on soil, stones, or wood that are below water level or are damp from dripping water, and on rocks in the upper part of the intertidal zone of the ocean. The strata are found in the basins of fountains, on the shores of rivers, and on the borders of falls, where the water is usually splashing on them. The filaments may be epiphytic, growing upon other aquatic plants or endophytic, growing in the front of *Batrachospermum* or within the gelatinous matrices of *Chaetophora* and various coccoid blue-green algae. The trichomes are bluish to brownish in color; the filaments are long and falsely branched or short and simple; the sheath is closed or expanded toward the apex, homogeneous or lamellated; and the cells may be constricted only in the lower portion of or throughout the whole trichome. The hormogonia either move out of or remain and regenerate within the sheath. In filaments where intercalary heterocysts prevent the escape of the hormogonia from the sheath, hormogonia create such pressure within the sheath during their growth that they burst through its sides and grow outward as branches. Branches may emerge singly or in pairs. Occasionally a hormogonium grows into a trichome attenuated, often into hairs, at both ends; and no heterocysts are developed. The same phenomenon can be seen in *C. crustacea*.

C. parietina is one of the algae about which calcium carbonate and siliceous sinter may be deposited. It is considered to be one of the important components in the formation of the hot spring terraces and cones (4). The calcium carbonate and silica fill the interstices among the filaments and leave the upper portions free. With the exclusion of light the cells of the lower portions of the filaments die or form hormogonia which pass upward out of the sheath and grow into new filaments at the surface of the mass.

Explanation of Figures.

Fig. 1. Calothrix parietina (Näg.) Thur. × 400.
Fig. 2. Calothrix pilosa Harv. × 200. Fig. 2a, Habit Sketch. × 50.
Fig. 3. Calothrix adscendens (Näg.) Born. & Flah. × 400.
Fig. 4. Calothrix juliana (Menegh.) Born. & Flah. × 400.
Fig. 5. Calothrix crustacea Thur. × 250.
Fig. 6. Calothrix confervicola (Roth) Ag. × 250.

Specimens studied : **Sweden** : Krokträsket prope Stockholmiam, K. BOHLIN, Aug. 23, 1896 (as *Calothrix fusca* in Wittr., Nordst. et Lagerh., Alg. Exs. 1304); Danviken prope Stockholmiam, G. LAGERHEIM, Jan. 28, Oct. 25, 1881 (as *C. parietina* in Wittr. et Nordst., Alg. Exs. 751a, b). **Poland** : Silesia : Skalitz bei Strehlen, HILSE, spring, 1862 (as *Leptothrix rosea* in Rabenh., Alg. Eur. 1467, D); auf dem Galgenberge bei Strehlen, HILSE (as *Mastichonema caespitosum* in Rabenh., Alg. Sachs. 871); Hatlein, SAUTER (as *Schizosiphon crustiformis* in Rabenh., Alg. Eur. 1124); Schwoitsch bei Breslau, HILSE, Nov. 20, 1864 (as *S. gracilis* in Rabenh., Alg. Eur. 1770); Peterwitzer, BLEISCH (as *Mastichothrix fusca* in Rabenh., Alg. Eur. 1499). **Czechoslovakia** : Moravia : Mohelno, F. NOVACEK, Mar. 18, June 12, 1926, Oct. 4, 1928. Bohemia : Turnov, Doksy, and Eichwald, A. HANSGIRG, July 1883; Belá and Carlsbad, HANSGIRG, Aug. 1883; Zehun u Chlumec, HANSGIRG, Sepl. 1883; Smichov and Trojsky ostrov, HANSGIRG, Oct. 1883; St. Prokop, HANSGIRG, May 1884, June 20, 1884 (as *Calothrix parietina* in Wittr. & Nordst., Alg. Exs. 751c); Karlstein and Chlumcany, HANSGIRG, July, 1884; Krumlov, HANSGIRG, Aug., Sept. 1884; Rosenberg im Erzgebirge und Hohenfurth, HANSGIRG, Aug. 1884; Slichow, HANSGIRG, Nov. 1884; Doubravice na Sázave, HANSGIRG, Sepl. 1885; Sárka, HANSGIRG, May 1886; Podhor u Prahy, Letkâm u Libsic, HANSGIRG, Aug. 1886; Sl. Prokop, HANSGIRG, Apr. 1887; Chotzen, HANSGIRG (as *C. salina* in Fl. Exs. Autro-Hung. 2395), July 1887; Vetrusic, HANSGIRG, July 1887; Zampach prope Eule, Velky Osek, Putim u Písku, HANSGIRG, Aug. 1887; Liboch, Tellnitz, and Karlstein, HANSGIRG, July 1888; Kornem nad Beroukou, Rozd'alovic, Libusina Lázen u Pankrace, HANSGIRG, Sept. 1888; Kowarow prope Mühlhausen, HANSGIRG, July 1890; Böhmisch-Leipa, HANSGIRG, Sept. 1890; prope Cáslav, HANSGIRG, 1891; Prokopital, ad Nova Ves prope St. Prokop, HANSGIRG (as *C. parietina* in Fl. Exs. Austro-Hung. 2394, and in Mus. Palat. Vindob. Krytp. Exs. 1006).

Austria : Jenbach, HANSGIRG, 1891; Graz, HANSGIRG, Sepl. 1890; Gleisdorf, Steiermark, HANSGIRG, Sept. 1890; auf dem Loser, Steiermark, K. REICHINGER *38a*, Sept. 13, 1907; Klagenfurt und Friesach, HANSGIRG, Sept. 1889. **Hungary** : Podersdorf ad lacum Peisonis, C. RECHINGER (as *C. parietina* in Mus. Palat. Vindob. Krypt. Exs. 1006b). **Jugoslavia** : Borsl-Clanz prope Tergeste, HANSGIRG, Aug. 1889; Cannosa-Valdinoce prope Ragusa, HANSGIRG, 1891; Castel Vecchio prope Spalato, HANSGIRG, Aug. 1889; Cherso, HANSGIRG, Aug. 1885; Fiume, HANSGIRG, 1891; Kaltenbrunn prope Laibach, HANSGIRG, Aug. 1889; Contovello (Triestino), HANSGIRG, 1891; Isola prope Pirano, HANSGIRG, July 1889; Lupoglava, HANSGIRG, Aug. 1889; Nieder-Tuzla, HANSGIRG, Aug. 1890; Pirano, HANSGIRG, Apr. 1889; Podnarl, HANSGIRG, Aug. 1889; Pola, HANSGIRG, Apr. 1889; Ragusa, HANSGIRG, 1891; Sebenico, HANSGIRG, Aug. 1888; St. Georgen-Pöltschach, HANSGIRG, Aug. 1890; Slrogniano prope Pirano, HANSGIRG, Apr. 1889; Tüffer, HANSGIRG, Aug. 1890; Veldes, HANSGIRG, Sept. 1889; Zara, HANSGIRG, Aug. 1888; Zengg, HANSGIRG, 1891; Zwis-

chenwässern-Bischoflack, HANSGIRG, Aug. 1889. **Greece** : Panormos, Mykonos, Island, K. H. RECHINGER *45*, Apr. 12, 1927. **Denmark** : Donse Mölle in Selandia, O. NORDSTEDT, Oct. 8, 1882 (as *Calothrix Braunii* in Wittr. et Nordst., Alg. Exs. 856). **Germany** : Freiburg, Baden *Anonymous*, 1869 (D); bei Eschenau (Schwäb. Hall), KEMMLER, Apr. 1858 (as *Mastichonema pluviale* in Rabenh., Alg. Sachs. 733); Teuditz und Kötzschau bei Leipzig, O. BULNHEIM, July 1857 (as *Schizosiphon salinus* in Rabenh., Alg. Sachs. 609); Leipzig, bei Grimma, P. RICHTER, Sept. 1868 (as *Mastigothrix aeruginea* in Rabenh., Alg. Eur. 2155).

Italy : Alghero, Sardinia, June 1886 (as *Schizosiphon crustiformis* in Marcucci, Un. Itin. Crypt. 1866, XXIIIh); Branzoll, Nabresina, Neumarkt, HANSGIRG, 1891; Miramar-Barcola prope Tergeste, HANSGIRG, Aug. 1889; Vercelli, *herb.* DE BREBISSON, CESATI, May 1856 (as *S. hirudinosus* in Rabenh., Alg. Sachs. 534). **France** : Maguelone prope Montpellier, C. FLAHAULT, Jan. 1884 (as *Calothrix parietina* in Wittr. et Nordst., Alg. Exs. 659); Angers, F. HY, Sept. 1886 (as *C. balearica* in Wittr. et Nordst., Alg. Exs. 851); Saint-Gilles près Saint-Lô, P. FRÉMY, Aug. (as *C. parietina* in Hamel, Alg. de France 9). **Madeira Islands** : LOWE coll. (D). **Angola** : Pungo Andongo, F. WELWITSCH *105*, Mar. 1857; Mossamedes, WELWITSCH *190*, Aug. 1859. **Bermuda** : Shore Hills, St. Georges Island, A. J. BERNATOWICZ *51-797*, Jan. 27, 1951; Walsingham Caves area, Hamilton Island, BERNATOWICZ *49-613*, Apr. 6, 1949; Castle Island, T. A. & A. STEPHENSON *BRCA2*, *BRCA6a*, July 21, 22, 1952; Cohhler's Island, STEPHENSON *BRC13b*, July 4-5, 1952; Whalebone Bay, STEPHENSON *BRW5b*, July 12, 1952. **Quebec** : top of Mt. Albert, H. HABEEB *1778*, June 28, 1951; Baie Kopaluk et riviere Payne, Ungava, J. ROUSSEAU *1096*, *1134*, Aug. 10, 1947, Aug. 11, 1948; Rawdon, Montcalm county, S. MARIE-JEAN-EUDES *232-41*, Aug. 7, 1939; Wakefield, Hull county, J. BRUNEL *393*, July 7, 1933. **Novo Scotia** : St. Margaret's Bay, Halifax county, T. A. & A. STEPHENSON *NSM9*, *NSM9d*, July-Sept. 1948. **New Brunswick** : Grand Falls, H. HABEEB *10034*, *10145*, *10302*, *10379*, *10452*, *10486*, *10657*, *10703*, *10708*, *10709*, *10723*, *10737*, *10751*, *10758*, *10774*, *10822*, *10858*, *11595*, *11663*, *11667-11669*, June 25, 1947, June 22, 1951; Blue Bell, Victoria county, HABEEB *10346*, July 7, 1948; mouth of Salmon river, Victoria county, HABEEB *11670*, June 24, 1951; Salt Springs, Sussex, HABEEB *13473*, *13474*, *13476*, *13480*, July 26, 1951. **Maine** : Mount Desert, F. S. COLLINS *3854*, July 11, 1900. **New Hampshire** : Chocorua Lake, W. G. FARLOW, Sept. 1906. **Massachusetts** : East Falmouth, R. N. WEBSTER & F. DROUET *2250*, June 22, 1938; Falmouth Heights, R. A. LEWIN, July 1949; Medford, COLLINS *6086*, Aug. 29, 1909; Madaket, Nantucket, B. F. D. RUNK, June 30, 1940; Williamstown, FARLOW; Woods Hole, COLLINS, June 23, 1906, COLLINS *5143*, Aug. 16, 1904. **Rhode Island** : Lincoln, COLLINS *5433*, Apr. 19, 1906 (as *C. parietina* in Coll., Hold. et Setch., Phyc. Bor.-Amer. 1360b).

Connecticut : Bridgeport, W. A. SETCHELL *389*, Nov. 15, 1891, SETCHELL & I. HOLDEN *1879*, *1898*, HOLDEN, Oct. 7, 1892, Oct. 22, 1893 (as *C. parietina* and *C. Braunii* in Coll., Hold. et Setch., Phyc. Bor.-Amer. 12, 112); North Bridgeport, L. N. JOHNSON *86*, Sept. 2, 1893; Norwich, SETCHELL

Source : MNHN Paris

414, Dec. 21, 1891; Yale Bird Preserve, New Haven, H. K. PHINNEY *1081*, July 28, 1946. **Ontario** : St. Lawrence river, Kingston, J. H. WALLACE *20*, *23*, July 1953; Niagara Falls, J. BLUM *141* (*H97*), Oct. 16, 1948. **New York** : Westerleigh, Staten Island, I. C. G. COOPER, Apr. 7, 1941; Lime Lake, Cattaraugus county, J. BLUM *133* (*H90*), Oct. 7, 1948; Allegany state park, BLUM *186* (*H157*), Dec. 29, 1948; Alden, BLUM *238* (*H202*), Apr. 20, 1949; Rowmansville, BLUM *201* (*H182*), Feb. 12, 1949; Buffalo, BLUM *171* (*H163*), Jan. 20, 1949; Scajaquada Creek, Erie county, BLUM *122* (*H87*), Oct. 2, 1948; Felkirk, BLUM *309* (*H250*), July 14, 1949; Sardinia, BLUM *167* (*H119*), Nov. 20, 1948; west of Union road, Erie county, BLUM *123* (*H83*), Oct. 2, 1948; Mendon Ponds park, Monroe county, BLUM *405*, Oct. 15, 1949; American falls, Niagara county, BLUM *140* (*H98*), Ot. 16, 1948; Reed's creek, Ontario county, D. HASKINGS *62*, 1944; Edwards, BLUM *325* (*H267*), July 28, 1949; North Java, BLUM *402* (*H317*), Oct. 6, 1949; Glen Iris north of Portageville, BLUM *296* (*H231*, *H232*, *H236*), June 1, 1949. **New Jersey** : Pleasantville, J. E. PETERS, Oct. 1892 (as *C. fusca* in Coll., Hold. et Setch., Phyc. Bor.-Amer. 11). **Pennsylvania** : Bethlehem, F. WOLLE (D); Nazareth, WOLLE, July 10, 1887; Derry Church, Dauphin county, WOLLE, Oct. 1887. **Delaware** : Rehoboth Beach, F. DROUET & H. B. LOUDERBACK *8562*, Aug. 24, 1948. **Maryland** : Cabin John, Montgomery county, DROUET & E. P. KILLIP *3956*, July 24, 1941, DROUET, KILLIP & D. RICHARDS *5570*, Aug. 7, 1944. **District of Columbia** : culture, Washington, F. E. ALLISON *20*, June 29, 1937 (D).

Virginia : Richmond, J. C. STRICKLAND, Mar. 4, 1948; Staunton, E. S. LUTTRELL & STRICKLAND *931*, July 26, 1941; Taysi, Dickenson county, STRICKLAND & LUTTRELL *1305*, Aug. 6, 1942; Kira, Giles county STRICKLAND *447*, Aug. 19, 1938; Mountain Lake, Giles county, STRICKLAND *130*, Aug. 5, 1938, I. F. LEWIS, July 27, 1939; Mt. Rogers, Grayson county, STRICKLAND *1074*, Aug. 26, 1941; Dot, Lee county, STRICKLAND & LUTTRELL *1361*, Aug. 7, 1942; Flat Rock, Powhatan county, STRICKLAND & LUTTRELL *1431*, Sept. 23, 1942; Claremont, Surry county, STRICKLAND *1429*, Sept. 13, 1942; Chappel's Mill Pond, Sussex county, LUTTRELL & STRICKLAND *855*, July 9, 1941. **West Virginia** : Stollings, Logan county, A. T. CROSS, Nov. 14, 1943. **North Carolina** : Beaufort, H. J. HUMM, Sept. 30, 1947, May 25, 1948, W. CULBERSON & C. S. NIELSEN *1749*, Aug. 25, 1949, L. G. WILLIAMS, 1948; Highway 181, Burke county, H. C. BOLD *H373*, July 26, 1939; Franklin, NIELSEN & CULBERSON *1894*, Sept. 3, 1949; Hot Springs, NIELSEN & CULBERSON *1806*, Sept. 1949; Highlands, BOLD *H39*, May 14, 1939; Toxaway gorge, BOLD *H106*, June 6, 1939. **South Carolina** : Walhalla, Oconee county, BOLD *H67*, *H68*, May 21, 1939; Gaffney, Cherokee county, P. J. PHILSON *58*, July 18, 1933; Florence, PHILSON *55*, July 5, 1933. **Georgia** : Forest Falls, Decatur county, R. M. HAPER *1194a*, Aug. 12, 1901; Warwoman Creek, Rabun county, BOLD *H382*, July 29, 1939.

Florida : Gainesville, M. A. BRANNON *D*, *3*, *36*, *39*, *78*, *99*, *142*, *195*, *204*, *302*, *316*, *327*, *329a*, *332*, *349*, *362*, *365*, *391*, Oct. 1941, May 1946; Orlando, BRANNON *351*, *367*, June 5, 1948; Tallahassee, BRANNON *51*, Mar. 31, 1942; Bunnell, Flagler county, P. C. STANDLEY *92779*, Mar. 18,

1946; Tampa, STANDLEY *92657*, Mar. 1946; Aspalaga, Liberty county, MADSEN, WAGNER, & PATES *2047*, Apr. 15, 1950; Florida Caverns state park, Jackson county, C. S. NIELSEN *3009*, Feb. 8, 1950, A. H. JOHNSTON, Dec. 10, 1950, NIELSEN, G. C. MADSEN & D. CROWSON *331*, Aug. 31, 1948, F. DROUET, NIELSEN, MADSEN & CROWSON *10405*, *10409*, Jan. 4, 1949; Steinhatchee, Taylor county, DROUET & NIELSEN *11227*, Jan. 23, 1949; Port Leon, Wakulla county, DROUET & E. M. ATWOOD *11461*, Jan. 26, 1949; St. Marks lightouse Wakulla county, DROUET, MADSEN & CROWSON *11738*, *11768*, Feb. 1, 1949, NIELSEN *10*, Oct. 4, 1951; McIntosh, Marion county, DROUET & BRANNON *11100*, Jan. 21, 1949; Hendry Creek south of Fort Myers, STANDLEY *73186*, Mar. 11-25, 1940; between Dania Beach and Hollywood Beach, DROUET & H. B. LOUDERBACK *10271*, Dec. 28, 1948; higway no. 61 (175), Leon county, DROUET, MADSEN & CROWSON *11535*, Jan. 27, 1949; Carrabelte, DROUET & NIELSEN *10963*, *11670*, *11672*, Jan. 16, 31, 1949; Alligator point, Franklin county, H. J. HUMM, July 27, 1952; Newport, NIELSEN, July 23, 1952, NIELSEN *160*, *174*, July 1948, DROUET, CROWSON & R. THORNTON *11357*, *11400b*, Jan. 25, 1949, A. H. JOHNSTON *54*, Nov. 11, 1950; Riverside, Wakulla county, DROUET, MADSEN & CROWSON *11525*, Jan. 27, 1949; Wakulla Springs, DROUET, MADSEN & CROWSON *11474*, Jan. 27, 1949; Gulf Beach, Escambia county, DROUET, NIELSEN, MADSEN & CROWSON *10556*, *10564*, *10565*, *10569*, Jan. 8, 1949; easl end of Santa Rosa Island, Okaloosa county, DROUET, NIELSEN, MADSEN, CROWSON & A. PATES *10632*, *10634*, Jan. 9, 1949; Panama City DROUET & NIELSEN *11609*, Jan. 30, 1949.

Michigan : Sturgeon Bay, J. BLUM *366* (*H297*), Aug. 24, 1949; Ann Arbor, L. N. JOHNSON *1019*, Oct. 30, 1893; Trout Lake, Chippewa county, H. K. PHINNEY *9M41-7-1*, July 19, 1941; Cheboygan, PHINNEY *28M39-3*, July 28, 1939. **Ohio** : Athens, W. A. DAILY *127*, Oct. 7, 1939; Canaanville, Athens county, A. H. BLICKLE *1*, July 1941; Cincinnati, C. M. PALMER, culture *22*, Mar. 18, 1952, DAILY *142*, *193*, *196*, *198*, Oct. 1939; North Appalachan Experimental Walershed, Coshocton county, L. J. KING *689*, Aug. 19, 1942; Glendale, Hamilton county, J. H. HOSKINS & DAILY *214*, Nov. 4, 1939; South Amherst, Lorain counly, F. K. & W. A. DAILY *610*, July 25, 1940; McConnelsville, BLICKLE, Ocl. 1939 South Bass Island, Ottawa county, BLUM *300* (*H245*), June 15, 1949. **Kentucky** : University of Louisville, T. W. TICHENOR *25*, Jan. 1940. **Tennessee** : Oak Ridge, M. S. DOTY *53-76*, July 14, 1953; Nashville, H. C. BOLD *155*, Oct. 10, 1938; Harrogate, BOLD *20*, June 26, 1938; Norris Dam, Anderson county, H. SILVA *1871*, Sept. 1, 1949; Abram's Falls, Blount county, SILVA *1887*, Sept. 9, 1949; Nolichucky Dam, Greene county, SILVA *913*, June 25, 1949; Knoxville, SILVA *853*, *834*, *2043*, June 18, 1949, Mar. 14, 1950, BOLD *2*, June 19, 1938; Walnul Log, Obion county, SILVA *1204*, July 2, 1949; Linden, Perry county, BOLD 16, Aug. 21, 1953; Dayton, Rhea counly, A. J. SHARP *1987*, Sept. 25, 1949; Little River Gorge, Sevier counly, SHARP *4116*, Sept. 8, 1941; Liltle Pigeon River, Porters Prong, and Elkmont, Sevier county, SILVA *127*, *209*, *1642*, Sept. 1941, Apr. 1942, Aug. 1949; Horse Creek, Washington counly, SILVA *471*, Jan. 14, 1947. **Alabama** : Pickwick Lake, Colbert county, T. F. HALL 1948, Sept. 4, 1949; Fort Morgan, R. L. CAYLOR *51-7a*, Aug. 1953. **Indiana** : Monticello,

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DAILY *868*, July 29, 1941; Indianapolis, W. A. & F. K. DAILY, F. DROUET, E. R. HUPP & C. M. PALMER *934, 942, 949*, Aug. 16, 1942, PALMER, R. N. WERSTER, R. PRETTYMAN, D. WEBSTER & DROUET *2520*, Aug. 17, 1939, PALMER, July 4, 1921 (D), PALMER *B722*, Oct. 7, 1946; North Vernon, F. K. & W. A. DAILY *1107a*, May 23, 1942; Bethany park, Morgan county, F. K. & W. A. DAILY *1065*, Sept. 20, 1942; Beverly Shores, Porter county, DROUET *5862*, Nov. 6, 1947; St. Paul, Shelby county, F. K. & W. A. DAILY *1139, 1143*, Oct. 3, 1943; Richmond, L. J. KING *26, 27, 301, 353, 374*, Aug. 13, Nov. 10, 1940.

Wisconsin : Madison, FORBES & A. B. SEYMOUR, Sept. 1885; H. B. LOUOERBACK & DROUET *5478, 5488, 5493, 5507*, July 22-23, 1944; Milwaukee, L. G. SMITH, June 27, 1945; Prairie du Chien, DROUET *5074, 5094*, Aug. 17, 1943. **Illinois** : Chicago, R. MCMILLAN *10 (GFS)*, Apr. 1954 (D), K. C. FAN *10615, 10621, 10623, 10632, 10636, 10644, 10647, 10658, 10659, 10652, 10661, 10662, 10664*, Aug.-Sept. 1954 (D, FA), P. D. VOTH, Mar. 18, 1941, A. E. VATTER JR., Nov. 16, 1949, D. RICHARDS & L. J. KING *1127*, Oct. 16, 1940, DROUET *4968, 5270, 5343, 5347*, June 1943-May 1944. DROUET, H. B. LOUOERBACK & R. LOUOERBACK *5345*, May 14, 1944, DROUET & LOUOERBACK *5353*, May 28, 1944, DROUET, H. K. PHINNEY & LOUOERBACK *5631*, July 5, 1945, KING, spring, 1941, W. A. & F. K. DAILY, LOUOERBACK & DROUET *5342*, Apr. 23, 1944; Blue Island, P. C. STANOLEY, Sept. 27, 1941; Lemont, G. T. VELASQUEZ, RICHARDS & DROUET *2504*, Aug. 4, 1939; Evanston, H. K. PHINNEY, Nov. 1, 9, 1943, PHINNEY *388*, Nov. 19, 1943; St. Charles, LOUDERBACK & DROUET *5312, 5774*, Apr. 14, 1944, July 27, 1947; northeast of Barrington, Lake county, STANDLEY & R. A. DOUBLEDAY *92414*, July 26-30, 1943; Reddick, E. M. SCHUGMAN, Sept. 9, 1943, May 29, 1944; Lake Glendale, Pope county, PHINNEY *977*, July 14, 1944. **Mississipi** : Bay St. Louis, DROUET *9858*, Dec. 9, 1948; Gulfport, DROUET & R. L. CAYLOR *9945, 9946*, Dec. 12, 1948; Cleveland, CAYLOR 25, Oct. 21, 1938.

Minnesota : Redby, Beltrami county, DROUET *12019* (D); Itasca state park, K. C. FAN *10005, 10142, 10531*, DROUET & FAN *11881*, DROUET *11925, 12131, 12242, 12243*, June-July 1954 (D, FA); Minneapolis, J. E. TILDEN, Aug. 3, 1895 (as *Calothix parietina* in Tild., Amer. Alg. 164), K. DAMANN, Aug. 1936. **Iowa** : Dane Ray, G. W. PRESCOTT *321*, July 12, 1926 (D). **Missouri** : Liberty, C. J. ELMORE, Feb. 20, 1938 (D); Columbia, DROUET *77, 689*, July 4, 1928, Sept. 24, 1930 (D); Chouteau Springs, Cooper county, DROUET *748*, Oct. 3, 1930 (D), DROUET & LOUOERBACK *5647*, Aug. 25, 1945; Ellis Ford, Camden county, C. SHOOP *97*, Sept. 21, 1938. **Arkansas** : Hot Springs, Lake Gertrude, 1000 Drippings Spring, and Fountain Lake, Garland county, N. E. GRAY *123, 126, 652, 670*, Aug. 16, 1939, Sept. 3, 4, 1940; Barton Warm Spring, Montgomery county, GRAY *629*, Aug. 31, 1940; Hot Springs county, GRAY *150*, Aug. 20, 1939. **Louisiana** : Baton Rouge, L. H. FLINT, June 1949, FLINT R-2, July 1, 1949; Lake Charles, DROUET *8758*, Oct. 28, 1948; Mandeville, DROUET & FLINT *9537, 9541, 9542, 9545*, Dec. 2, 1948; Lake Pontchartrain at highway no. 11, DROUET & P. VIOSCA JR. *9323*, Nov. 24, 1948; New-Orleans, DROUET & VIOSCA *9379, 9381, 9386*, Nov. 24, 1948; between Leeville and Chenier Caminada, Lafourche parish, DROUET & VIOSCA *9455*, Nov. 26, 1948; Covington, FLINT, Aug. 4, 1943; Calhoun, FLINT *4*, Oct. 31, 1944; Hammond, FLINT, Feb. 21, 1945.

Nebraska : Kimball, W. KIENER *22653*, *22665*, *22665a*, Aug. 17, 1947; Lincoln, G. H. GILES, Apr. 19, 1938 (D), E. R. WALKER, 1908-1909, KIENER *21620*, *23915*, *24103*, Dec. 1946-Aug. 1948; Angora, Morrill county, KIENER *11541*, Aug. 27, 1941; Columbus, KIENER *19930*, Aug. 24, 1946; Verdon, KIENER *21385b*, Aug. 16, 1946; Oshkosh, KIENER *18813c*, *18815b*, *23135*, Dec. 26, 1945, Feb. 1, 1949; Aurora, KIENER *15016*, Aug. 25, 1943; Hayes Center, KIENER *21134*, July 27, 1946; Lake McConaughey, KIENER *22302*, Aug. 20, 1948; Eagle Canyon, Keith county, KIENER *22470*, July 27, 1947; Fremont, KIENER *13946*, Apr. 23, 1943; Lexington, KIENER *15977*, Oct. 14, 1943; Parks, KIENER *21214*, *21215*, July 29, 1946; north of Parks, KIENER *21865*, *21878a*, Mar. 28, 1947; Benkelman, KIENER *16550*, Apr. 25, 1944; Rock Creek Hatchery, Dundy county, KIENER *19551*, *19552*, Aug. 3, 1945; Rock Creek Lake state park, Dundy county, KIENER *19828*, Oct. 5, 1945; Beeken lake south of Arthur, KIENER *16068*, *21203*, Oct. 22, 1943, July 5, 1946; Harrisburg, KIENER *22139a*, *22139b*, May 22, 1947; Merriman, Cherry county, KIENER *22216*, May 26, 1947; Valentine, KIENER *23774*, *23781*, *23823*, June 18, 1948; Chadron state park, Dawes county, KIENER *20375*, May 15, 1946. **Kansas** : Pittsburg, M. BACKER & R. PATRICK, Sept. 5, 1938; Kansas City, PATRICK, Aug. 1938. **Texas** : Austin, J. T. PAINTER & F. A. BARKLEY *13724* Nov. 11, 1943; Bastrop state park, J. COHN & BARKLEY *13683*, Sept. 4, 1943; Padre Island, Nueces county, E. WHITEHOUSE *24530*, Nov. 23, 1950; Eagle Lake, Colorado county, B. H. WARNOCK, BARKLEY & B. C. THARP *46402*, Aug. 21, 1946; Dallas, KIENER *12381*, *12383*, Dec. 30, 1941; Brownsville, R. RUNYON *3744*, *3963*, June 18, 1944, July 1, 1945. Montana : Kalispell, H. F. BUELL *468*, July 28, 1946; Missoula, M. FORBES *4326a*, Oct. 18, 1941, BARKLEY *424*, Mar. 26, 1942.

Wyoming : Centennial, Albany county, W. G. SOLHEIM, July 10, 1940; Yellowstone national park, W. H. WEED, 1897 (as *Calothrix thermalis* in Tild., Amer. Alg. 287), W. A. SETCHELL *1891*, *1900-1902*, *1910-1913*, *1927*, *1928*, *1931b*, *1945*, *1946*, *1948*, *1950*, *1977*, *1979*, *1980*, *1983*, *6136*, *6142*, *6145*, Aug. 21-31, 1898, July 28, 29, 1905. **Colorado** : base of Longs Peak, Boulder county, KIENER *2346*, Oct. 13, 1936; South Colony Creek, Custer county, KIENER *10275*, July 8, 1941; Cañon City, H. B. LOUDERBACK, Aug. 24, 1946. **New Mexico** : Mimbres Hot Springs, Grant county, J. F. MACBRIDE, W. GILLESPIE & W. R. OVERTON *8192*, Nov. 1946; Tularosa basin, Dona Ana county, A. A. LINDSEY, June 3, 1947; Montezuma (Hot Springs), San Miguel county, F. DROUET & D. RICHARDS *2628*, *2639*, *2646*, Oct. 19, 1939; Grant, Valencia county, LINDSEY, July 29, Aug. 13, 1944, May 12, 1945, May 25, 1947, N. E. GRAY *29*, Aug. 8, 1941. **Utah** : Centerville, DROUET, RICHARD & J. RUBINSTEIN *4705*, Sept. 7, 1941. **Arizona** : Marble Canyon, Coconino county, E. U. CLOVER & L. JOTTER *40*, July 16, 1938; Supai, Coconino county, CLOVER *11*, Sept. 16, 1940. **Nevada** : Walker, Mineral county, W. A. ARCHER *6960*, Sept. 5, 1948; Fish Lake spring, Esmeralda county, T. FRANTZ *1566*, June 7, 1952; Steamboat, M. J. GROESBECK *116*, *191*, *194*, *278*, *362*, *376*, *428*, *429*, *447*, *448*, June 1940-July 1941. **British Columbia** : Vancouver, M. ASHTON *3*, May 11, 1936 (D). **Washington** : Lake Union, King county, J. E. TILDEN, June 26, 1897 (as *C. Braunii* in Tild., Amer. Alg. *286b*); Columbia river, Richland, R. G. GENOWAY, Dec. 1, 1952; Columbia river, Benton county, C. C. PALMITER *53*, May 1, 1953. **Oregon** : Kitson Springs, Lane county, M. DOTY *7324*, Oct. 22, 1939; Willamette river, Lane county, DOTY *8900*, Sept. 18, 1951.

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California : North Berkeley, N. L. GARDNER, Sept. 24, 1905 (as *C. parietina* in Colt., Hold & Setch. Phyc. Bor.-Amer. *1360d*), GARDNER *943*, Mar. 1903; Oakland, W. J. V. OSTERHOUT & GARDNER *1114*, July 4, 1903, GARDNER *4562*, Jan. 24, 1920; Berkeley, GARDNER, Feb. 10, 1906 (as *C. parietina* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1360a), Mar. 1916 (as *C. fusca* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 2212), Jan. 1916 (as *C. Braunii* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 2211), OSTERHOUT & GARDNER, July 1905 (as *C. parietina* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1360c), GARDNER *1150, 1490, 3253, 6594, 7191*, Aug. 1903-Mar. 1933, OSTERHOUT & GARDNER *1438*, Dec. 10, 1904, M. B. NICHOLS *6376*, Sept. 1906; Santa Cruz Island, P. C. SILVA *6018a*, Mar. 11, 1950; San Francisco, GARDNER *21, 7432*, Oct. 20, 1900, July 29, 1933, V. DURAN *6598*, Apr. 16, 1931; San Leandro, GARDNER & OSTERHOUT 1501, July 1905; Mount Hamilton Range, Alameda county, GARDNER & A. CARTER *8010*, Nov. 22, 1936; Tassajara Hot Springs, Contra Costa county, GARDNER *7950*, May 11, 1936; Lone Pine, M. J. GROESBECK *79*, June 17, 1940; Little Lake, Inyo county, GROESBECK *224, 306*, Nov. 23, 1940, Apr. 2, 1941; La Verne, G. J. HOLLENBERG *651*, Feb. 21, 1935 (D); Pomona, HOLLENBERG *1537*, Sept. 27, 1936; San Fernando, DROUET *5756*, Sept. 8, 1946, DROUET & A. A. COHEN *5743, 5748*, Sept. 9, 1946; La Canada, Los Angeles county, E. W. CHAMBERS *6770*, Aug. 1931; Bodega bay, Marin county, W. A. SETCHELL *3022*, Dec. 12, 1898; Bridgeport, GROESBECK *41, 42, 95, 248, 251, 269, 335, 341, 344, 463, 480, 483*, Apr. 1940-July 1941, A. M. ALEXANDER & L. KELLOGG, June 30, 1944; Fales Hot Springs, Mono county, GROESBECK *188*, Sept. 4, 1940; Palm Springs, DROUET & J. F. MACBRIDE *4730, 4745*, Oct. 15, 1941; Arrowhead Hot Springs, San Bernardino county, SETCHELL *1536, 1542, 1546*, Dec. 19, 1896, H. E. PARKS *3247b*, Dec. 1929; Waterman Hot Springs, San Bernardino county, SETCHELL *1552, 1556, 1557*, Dec. 19, 1896; Tan Foran Race Track, San Mateo county, GARDNER *1288*, Jan. 31, 1904; Stanford Farm, San Mateo county, GARDNER *3249b*, Mar. 1916; Clear creek, Santa Barbara county, GROESBECK *514*, Dec. 5, 1941; Stanford University, Santa Clara county, DROUET, D. RICHARDS & D. A. JOHANSEN *4316*, Sept. 29, 1941; Weaverville, DROUET & RICHARDS *4257*, Sept. 19, 1941; Springville, Tulare county, DROUET & GROESBECK *4456*, Oct. 5, 1941.

Bahama Islands : Bimini Island, H. J. HUMM *15*, Apr. 1, 1948. **Puerto Rico** : Coamo Springs, N. WILLE *1899*, Mar. 21, 1915. **Jamaica** : Hope, St. Andrew, F. A. BARKLEY *22J028cVIII*, May 23, 1952. **Mexico** : Mexico City, R. PATRICK *150*, July 19, 1947; San Jose de Purua, Michoacan, PATRICK *425, 426, 389*, Aug. 3, 4, 1947; Lake Chapala, Michoacan, PATRICK *702*, Aug. 23, 1947; Bahia Kino, Sonora, DROUET & RICHARDS *2903*, Nov. 10, 1939. **Guatemala** : Lago de Amatitlán, P. C. STANDLEY *89473*, Mar. 15, 1941; Jutiapa, STANDLEY *75366*, Oct. 24-Nov. 5, 1940; Lago de Atitlán, J. A. STEYERMARK *47286*, June 7, 1942. **El Salvador** : Lago de Coatepeque, M. C. CARLSON, 1946; Metapán, STANDLEY & E. PADILLA *V. 3167*, Jan. 29-Feb. 1, 1947. **Honduras** : El Zammorano, STANDLEY, *2203, 4994*, 1946-1947; Las Casitas, dept. El Paraiso, STANDLEY, L. WILLIAMS & P. ALLEN *581*, Dec. 4, 1946; La Lima, STANDLEY & J. CHACÓN P. 7150, Apr. 11-20, 1947. **Nicaragua** : La Libertad, STANDLEY *8953*, May 29-June 1, 1947. **Costa Rica** : Turrialba, R. W. HOLM & H. H. ILTIS *1013*, July 14, 1949. **Panama Canal Zone** : Rio Pilon, G. W. PRESCOTT *CZ147*, Sept. 1939. **Ecuador** : Banos, prov. Tunguralhua,

G. LAGERHEIM, Dec. 30, 1891 (as *Calothrix thermalis* in Wittr., Nordst. & Lagerh., Alg. Exs. 1306). **Peru** : Arequipa, A. MALDONADO *11*, July 1950; Cuistalima, Lago Chilca, MALDONADO *66*, Jan. 1942; Ica, MALDONADO *300b*, Jan. 1943. **Brazil** : Manaos, J. W. H. TRAIL, Dec. 27, 1874 (D); Maceio, Alagoas, DROUET *1261*, June 16, 1935 (D). **Uruguay** : prov. San José, J. ARECHAVALETA, Apr. 1889 (as *C. fusca* in Wittr., Nordst. & Lagerh., Alg. Exs. 1303). **Argentina** : Buenos Aires, R. THAXTER, 1905-1906 (D), D. RABINOVICH, July 1943, Dec. 1943; Chascomus, prov. Buenos Aires, S. WRIGHT *2102*, Nov. 19, 1936 (D).

Antarctica : Budd coast, D. C. NUTT *68*, Jan. 19, 1948. **Hawaiian Islands** : Hilo, W. A. SETCHELL *5209*, July 14, 1900. **Tuamotu Archipelago** : Raroia atoll, M. S. DOTY & J. NEWHOUSE *11145*, *11876*, *11877*, July, Aug. 1952. **Marshall Islands** : Aomoen Island, Bikini atoll, J. TRACY, Aug. 6, 1946; Enejelto islet. Wotho atoll, F. R. FOSBERG *34425a*, Mar. 19, 1952. **New Zealand** : Auckland, V. W. LINDAUER *301*, Jan. 30, 1948; Stanley bay, Whangaparaoa peninsula, V. J. CHAPMAN *5*, Sept. 1947; Orakeikorako (East Taupo), SETCHELL *5979 (70)*, May 7, 1904; Great Wairakei geyser, Taupo county, SETCHELL *5963 (54)*, May 4, 1904; Rotorua, P. J. PHILSON & I. B. WARNOCK, A. NASH & L. A. DOORE, PHILSON & T. T. EARLE, Feb. 1935 (as *C. parietina* in Tild., So. Pacific Pl., 2nd Ser., 529, 564, 569, 570); Kororareka point, Bay of Islands, I. B. & V. R. WARNOCK, Jan. 16, 1935 (as *C. parietina* in Tild., So. Pacific Pl., 2nd Ser., 360). **Philippines** : Narvacan beach, Ilocos sur prov., M. M. KALAW *4*, June 12, 1935 (D); Diliman, Quezon City, G. T. VELASQUEZ *2526*, Feb. 1950; Iloilo City, J. D. SORIANO *1057*, July 6, 1952; Iwahing Penal Colony, Palawan, VELASQUEZ *2869*, June 18, 1951. **China** : Kushan near Foochow, and Fuling Hot Springs, Fukien prov., H. H. CHUNG *A417*, *A461*, Aug., Sept. 1926 (D); Tsishiasan, Kiangsu prov., C. C. WANG *371*, Apr. 1930; Nanking, WANG *358*, *359*, *382*, Sept. 28, 1930, Oct. 30, 1930, Mar. 16, 1931. **Burma** : Thingangyun, L. P. KHANNA *838*, Feb. 17, 1938; Rangoon, KHANNA *389*, *515*, May 30, Nov. 25, 1935. **Australia** : Teviot creek, Queensland, A. B. CRIBB M, Apr. 27, 1948. **India** : Himalayas, M. R. SUXENA *539*, 1955 (D). **Afghanistan** : W. SIMPSON, Apr. 1879 (D).

CALOTHRIX ADSCENDENS (Nägeli) Bornet et Flahault.

Fila sparsa, erecta, stellata, simplicia, rigida, ad 1.5 mm. alta, 5-25 μ crassa, ud basem saepe incrassata, vagina crassa, arcta, achroa vel luteo-fusca; trichomatibus 4-22 μ crassis, aerugineis vel luteo-fuscis; articulis 3-4 plo-brevioribus; heterocystis singulis, basilaribus. Fig. 3.

Filaments of *C. adscendens* are usually found erect on rocks and aquatic plants attached by their thickened bases. They simulate those of *C. juliana*, but each filament has a distinct basal heterocyst. A single heterocyst develops at one end of a hormogonium; the other end curves and grows erect. The basal portion of the sheath gradually becomes thickened and firmly fastened to the substratum. Mature filaments are fragile and easily broken.

Source: MNHN, Paris

Specimens studied : **Massachusetts** : Brewster, F. S. COLLINS, Sept. 10; 1912 (as *Calothrix stellaris* in coll., Hold & Setch., Phyc. Bor.-Amer. 1953). **Indiana** : Indianapolis, C. M. PALMER, July 4, 1931 (D). **Arkansas** : Warm Springs, N. E. GRAY, Sept. 4, 1940. **Guatemala** : Lake Amatitlan, W. A. KELLERMAN *5068*, Jan. 30, 1906 (as *Lyngbya lagerheimii* in Tild., Amer. Alg. 636). **Honduras** : Comayagua, P. C. STANDLEY & J. CHACÓN P. *4994a*, Mar. 12-23, 1947. **Uruguay** : La Palma, W. G. HERTER *99553*, Apr. 11-16, 1938. **Burma** : Kauadaugyi, Rangoon, L. P. KHANNA *507*, Nov. 22, 1935.

CALOTHRIX CONFERVICOLA (Roth) Agardh.

Fila greguria stellatim fasciculata, in algis majoribus affixa vel inter fila peripheria Nemalionis et Punctariae immersa, ad 3 mm. alta, 8-30 μ crassa, basi subaequalia vel bulbosa, vagina arcta vel dilatato-infundibuliforme, achroa vel luteo-fusca; trichomatibus 7-27 μ crassis, aeruginosis, purpureis, vel luteo-fuscis, articulis diametro 3-4 plo brevioribus; heterocystis 1-5 basilaribus Fig. 6.

Filaments of *C. confervicola* usually are epiphytic on marine plants, especially the Ceramiaceae. They also may be partly endophytic in the gelatinous fronds of *Nemulion* and *Punctaria* : the basal portions become large and bulb-shaped, just as do those of *C. parietina* and *C. juliana* where growing in the gelatinous fronds of Batrachospermum. The cell at the larger end of each young trichome develops into a heterocyst. As the filament elongates, the upper end bends upward and grows erect, free from the substratum. The mature filament is attached to the substratum by its horizontal or decumbent basal portion. Three to five heterocysts may develop successively as the filament increases in lenght.

Specimens studied : **Sweden** : Varberg, Halland, D. E. HYLMÖ, Aug. 18, 1928 (D), Sept. 7, 1933; in mari Bahusiae, A. ARESCHOUG, Aug. (as *Leibleinia confervicola* in J. E. Areschoug, Alg. Scand. Exs., Ser. Nov. 192). **Denmark** : Fionia, *herb.* LYNGBYE. **Germany** : Bülk, Holstein, REINKE, Oct. 1886 (D). **England** : Torquay, W. H. HARVEY, Aug. 1844, *herb.* CORRENS, 1845; Weymouth, A. LEIPNER, July 1866 (as *Lyngbya confervicola* in Rab., Alg. Eur. 1881); Torbay, M. WYATT (as *Calothrix confervicola* in Wyatt, Suppl. Alg. Danmon. 229). **France** : Banyuls, C. FLAHAULT, Oct. 20, 1886 (as *Calothrix parasitica* in Wittr. & Nordst., Alg. Exs. 854); Cherbourg, *herb.* DE BRÉBISSON, G. THURET, Aug. 2, 1856, *herb.* CORRENS, Sept. 1861; Conant Beach, Brittany, L. LYLE, Aug. 6, 1926; Equeurdrevelle, Manche, M. DOUBLET, Sept. 5, 1910; Le Croisic, THURET, Aug. 27, 1873; Porspoder, northwest of Brest, A. TAUGUY, Aug. 1885; St-Malo, THURET, Aug. 5, 1872; Saint-Servan, Ille-et-Vilaine, A. HAMEL-J., Aug. (as *Calothrix confervicola* in Hamel, Alg. de France 102).

Nova Scotia : Halifax Harbor, M. A. HOWE *1047*, Sept. 2-7, 1901 (D). **Maine** : Cape Rosier, F. S. COLLINS *1468;* Harpswell, COLLINS *5330a*, 1905. **Massachusetts** : Madaket, Nantucket Island, W. R. TAYLOR & B. F. D. RUNK, July 16, 1938 (D); Gay Head, Marthas Vineyard, H.

C. Bold, Aug. 5, 1954 (D); Cuttyhunk, A. B. Seymour, July 1, 1896, W. B. Maxon, July (as *Calothrix parasitica* in Mus. Hist. Nat. Vindob., Krypt. Exs. 2550); Woods Hole, F. Drouet *1884*, July 17, 1936 (D), W. G. Farlow, (as *Calothrix parasitica* and *C. confervicola* in Farl., Anders. & Eaton, Alg. Exs. Am. Bor. 224, 225), 1876, W. A. Setchell, July 12, 1892 (as *C. confervicola* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 9), A. B. Hervey, July 30, 1880, C. P. Nott, July 29, 1895 (as *C. parasitica* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 111), H. Croasdale, July 22, 1931, B. Livingston, Aug. 1875; Nobska point, Falmouth, M. Thurlow, June 28, 1936 (D), J. Bader *93*, July 23, 1938 (D), G. H. Giles, June 29, 1936 (D), F. Drouet *2080*, July 5, 1937 (D), W. R. Maxon *11141*, July 27, 1908, M. Doty *7373*, July 15, 1948; Penikese Island, W. B. Taylor, July 1, 1936 (D), Doty *6958a*, July 1, 1947, W. R. Dudley, 1874.

Rhode Island : Newport, W. G. Farlow. **New York** : College Point, H. Averill, Sept. 10, 1872. **Mississipi** : Fort Massachusetts, Ship Island, L. H. Flint 2, Jan. 29, 1954 (D). **California** : Laguna Beach, G. J. Hollenberg *1332*, May 8, 1936 (D). **Brazil** : Laguna, Santa Catarina, A. B. Joly *1054-1952*, Dec. 5, 1952 (D). **Japan** : Kato, Ohama bay, Fukui pref., I. Umezaki 8, June 22, 1949 (D). **Australia**: : Port Arthur, M. H. & L. M. Jones, Dec. 13, 1934 (as *C. parasitica* in Tild., So. Pacific Pl., 2nd Ser., 260); Vivonne bay, Kangaroo Island, H. B. S. Womersley *A2206 (K16)*, *A2206d (K16d)*, Jan. 3, 1946.

CALOTHRIX PILOSA Harvey.

Stratum caespitosum, late expansum, filis ad 10 mm. altis, 15-40 μ crassis, etongatis, rigidis, basi intertextis decumbentibus, utrinque erectis, liberis vel in fasciculos lateraliter concretis; ramis saepissime in modum Scytonematum egredientibus; vagina crassa, dura, aeruginea vel luteo-fusca; trichomatibus 10-20 μ crassis, superne breviter attenuatis, in cellula hemisphaerica terminatis; heterocystis illinc interruptis. Fig. 2.

C. pilosa grows on muddy beaches and on rocks at high tide line and in intertidal zones. Well developed strata can be recognized by the fasciculate aggregated filaments which stand rigid and erect. Both the branching and habit of the filaments are *Scytonema*-like. The intercalary heterocysts are usually longer than broad. The trichomes are evidently attenuated while young but with age they become cylindrical, with the attenuation confined to nodule-like tips. As the hormogonium grows, it becomes reduced in diameter toward one end or both ends. In the latter case a cell in the middle portion usually differentiates as a heterocyst. Where the hormogonia cannot move out of the sheath because of the presence of intercalary heterocysts, they often begin to grow *in situ;* the pressure resulting from their growth becomes so great that they burst through the sheath and grow outward as branches of the filament. The trichome may emerge as a loop which soon breaks, and thus

Source MNHN Paris

forms two branches side by side; lhis branching is *Scytonema*-like. If the burst occurs adjacent to a heterocyst, one branch is formed in a *Tolypothrix*-like fashion.

Specimens studied : **Bermuda** : Castle Island, T. A. STEPHENSON *BRCA3, BRCA7*, July 21, 22, 1953; Bailey's Bay, T. A. & A. STEPHENSON *BRMI1*, Aug. 8, 1952; Stovel Bay, Hamilton Island, W. R. TAYLOR *49-1968*, June 6, 1949; Pear Rock, St. Davids Island, A. J. BERNATOWICZ *49-786*, Apr. 12, 1949; Ray Island, BERNATOWICZ *49-1695*, May 10, 1949; Castle Harbor, BERNATOWICZ *49-1849*, May 25, 1949; Richardson's cove, St. Georges Island, BERNATOWICZ *49-1875, 49-2192*, May 26, 1949, Sept. 1, 1949. **Florida** : Key West, W. H. HARVEY *126* (D); Cudjoe's Key, C. L. POLLARD, G. N. COLLINS & E. L. MORRIS *92*, Mar. 16, 1898 (D). **Bahama Islands** : Nassau, M. A. HOWE *3006, 3032* (D), Apr. 7, 8, 1904; Bimini Island, M. A. HOWE *3256*, Apr. 17, 1904 (D), H. J. HUMM 7, 12, Mar. 30, Apr. 2, 1948. **Puerto Rico** : HOWE, May, 1903 (as *Calothrix pilosa* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1167); Lemon Bay near Guánica, HOWE *2609*, June 27, 1903 (D); Santurce, H. L. BLOMQUIST *11849, 12138*, Sept. 24, Nov. 6, 1941; Condado, San Juan, BLOMQUIST *13083, 13188a*, Apr. 7, 28, 1942. **Trinidad** : R. THAXTER, 1912-13 (D). **Tobago Island** : Roxborough Bay, THAXTER, 1912-13 (D). **Jamanica** : Port Antonio, C. E. PEASE & E. BUTLER (D); Robins Bay, C. R. ORCUTT *4682*, Jan. 27, 1928 (D). **Mexico** : Clarion Island, Revilla Gigedo Islands, W. R. TAYLOR *57*, Jan. 5, 1934 (D); Maria Madgdalena Island, Islas Tres Marias, TAYLOR *39-673*, May 9, 1939. **Costa Rica** : between Rio Sándoval and Río Tigre, C. W. DODGE *4537A*, May 1, 1930 (D).

Brazil : Natal, Rio Grande do Norte, F. DROUET *1527*, June 19, 1955 (D); Caiobá, Parana, A. B. JOLY *382*, Nov. 4, 1950; Ilha Santo Amaro, Santos, JOLY *324*, Sept. 13, 1950; Peruibe, São Paulo, JOLY *412, 422*, Jan, 3, 1951, Itanhaen, São Paulo, JOLY *441, 442*, Jan, 2, 1951; Ilha São Sebastiao São Paulo, JOLY *637*, Mar. 24, 1951. **Ecuador** : Galapagos Islands : Fernandina Island, W. R. TAYLOR *154*, Jan. 14, 1934 (D); Isabela Island, TAYLOR *94A*, 96 (D), Jan. 12, 1934. **Hawaiian Islands** : Keei, Hawaii, M. REED *20*, July 2, 1904; Pahala plantation beach, Hawaii, J. E. TILDEN, July 4, 1900 (as *Scytonema hawaiiana* in Tild., Amer. Alg. 573); Barking Sands, Kauai, W. A. SETCHELL *10684*, July 25, 1924; Manaa, Kauai, M. REED *379*, Aug. 11, 1905; Hanauna Bay, Oahu, M. DOTY *8648*, Feb. 17, 1951; Honolulu, W. J. NEWHOUSE *98, 110*, Sept. 1, 16, 1953; Kawela, Oahu, DOTY *8040*, Sept. 16-17, 1950, C. J. ENGARD, Nov. 23, 1940; Koolauloa, Oahu, TILDEN, June 16, 1900 (as *S. hawaiiana* var. *terrestris* in Tild., Amer. Alg. 574); Mokuleia, Oahu, A. KRUCKEBERG, Nov. 21, 1944. **Marshall Islands** : Ine Island, Arno atoll, L. HORWITZ *9554*, Aug. 16, 1951; Ameu Island, Bikini atoll, R. F. PALUMBO Y-28, July 27, 1949; Eniirikku Island, Bikini atoll, *W. R. TAYLOR *46-41*, Mar. 18-20, 1946. **Gilbert Islands** : MRS. R. CATALA *48, 51*, 1951. **New Zealand** : Stewart Island, A. NASH, Feb. 27, 1935 (as *Calothrix pilosa* in Tild., So. Pacific Pl., 2nd Ser., 793). **Japan** : Ao-shima and Kato, Ohama bay, Fukui pref., I. UMEZAKI *3, 55*, June 25, Sept. 8, 1949 (D); Nakano-sihma, Tokano Islande, E. OGATA *1141*, June 5, 1953 (D). **Philippines** : Baler, Tayabas, J. V. SANTOS *364*, Sept. 22, 1935 (D); Biliran, Leyte, R. C. MCGREGOR *4767*, June 20, 1914; Puerto Galera, Mindoro, H. H. BARTLETT *14033*, Apr. 1935 (D), G. T. VELASQUEZ *1151, 1788, 1928, 1929*, June 1, 1946, May 4, 1948, May 9, 1949; Sanga-Sanga, Tawi-Tawi, VELASQUEZ *3223*,

Source MNHN Paris

3224, May 12, 1952. **New Caledonia** : Ile aux Canards, V. MAY *310*, May 28, 1949. **China** : Liu-wu-tien, Amoy, C. Y. CHIAO, *A30*, July 29, 1932. **Viet Nam** : Cauda, E. Y. DAWSON *11065*, Jan. 23, 1953. **Australia** : Brampton Island off Mackay, Queensland, MAY *2701*, June 16, 1948; Port Arthur, Tasmania, A. B. CRIBB *115-9*, Jan. 22, 1951. **Mauritius** : Baie de 4 Cocos, Flacq, N. PIKE, Jan. 24, 1870 (D).

CALOTHRIX CRUSTACEA Thuret.

Stratum caespitosum, late expansum, velutinum vel poroso-fasciculatum, filis ad 5 mm. altis, 9-45 μ crassis, decumbentibus vel densissime stipatis, tortuosis et crispis, juvenilibus simpticibus, adultis pseudo-ramosis; ramis in modum Scytonematum et Tolypothrichum egredientibus vel fasciculatim congestis; vagina achroa vel luteo-fusca, tenue vel crassa, gelatinosa, homogenea vel lamellosa; trichomatibus 7-35 μ crassis, nigro-viridibus vel fuscescentibus, apice saepe in pilum terminantibus; articulis in summa parte diametro 3-4 plo brevioribus, cylindraceis, aetate provectiore articulis diametro brevioribus, saepe torutosis; heterocystis basilaribus et intercalaribus paucis. Fig. 5.

This is the most common and widely distributed species of *Calothrix* in the marine flora. It grows on rocks, gravel, sand, pilings, and shells and on the other larger aquatic plants in marsh pools and intertidal zones. The filaments are quite varied in size; often considerable variation can be seen within one collection. Where the hormogonia proceed to grow within the sheath, *Scytonema*-like and *Totypothrix*-like branches are formed as in *C. parietina* and *C. pitosa*. Often the hormogonia develop rapidly and simultaneously within and through the upper end of the sheath in a fasciculate fashion. Hormogonia occasionally grow with attenuation at both ends, as they sometimes do in *C. parietina*. Heterocysts may or may not be formed in such trichomes. A single heterocyst usually develops at the base of the young trichome, and others develop in succession above it as the filament ages. Intercalary heterocysts are formed in the older portions of the filament.

Specimens studied : **Norway** : Dröbak, H. G. SIMMONS, Apr. 10, 1898 (D); Svinör prope Lindesnäs, M. FOSLIE, Aug. 21, 1885 (as *Calothrix scopulorum* in Wittr. & Nordst., Alg. Exs. 852); Kjelmö in Finmarkia orientali, FOSLIE, Aug. 1, 1887 (as *C. vivipara* in Wittr., Nordst. & Lagerh., Alg. Exs. 1307a). **Sweden** : Klubban, Bohuslän, *Anonymous*, 1862 (D); in mari Bahusiae, Aug. (as *C. scopulorum* in Aresch., Alg. Sand. Exs., Ser. Nov. 139), S. AKERMARK (as *C. scopulorum* in Aresh., Alg. Scand. Exs., Ser. Nov., 235; as *C. scopulorum* and *Schizosiphon fasciculatus* in Rabenh., Alg. Eur. 1780, 1869), F. R. KJELLMAN & V. WITTROCK, July (as *Calothrix scopulorum* in Wittr. & Nordst., Alg. Exs. 191); Malmö, O. NORDSTEDT, Sept. 21, 1877, Nov. 16, 1878 (as *C. scopulorum* in Wittr. & Nordst., Alg. Exs. 484 a, b). **Denmark** : Fionia, *herb.*

Source: MNHN Paris

LYNGBYE. **Romania** : Constanta, E. C. TEODORESCU, Apr. (as *C. scopulorum* in Mus. Palat. Vindob. Krypt Exs. 1007), TEODORESCU *1278*, Apr. 1903. **Germany** : Heppenserdrift & Mariensiehl, Jever, May-Aug. (as *Ceramium pulvinatum* in Jürgens, Alg. Aquat., Dec. 4 : 5). **Jugoslavia**: Cherso, *herb.* LENORMAND (D) ; Abbazia, Istria, A. HANSGIRG, Aug. 1885 Strogniano, Fasano, et Isola prope Pirano, HANSGIRG, Apr., July, 1889; Pola, HANSGIRG, Apr., 1889; Rovigno, Istria, HANSGIRG, Apr., 1889. **Italy** : Trieste, *herb.* LENORMAND (D); Cagliari, Sardinia, Mar. (as *Scytonema sp.* in Marcucci, Un. Itin. Crypt. 1866, XXVII); Genoa, F. T. KÜEZING. **Wales** : Anglesey, J. R. LEWIS, Nov. 1950; Aberystwyth, LEWIS *1, 3, 4*, Apr. 7, 1953.

France : *herb.* LENORMAND (D); la Normandie (D); Ambleteuse prope Boulegne-sur-Mer, C. FLAHAULT, Aug. 18, 1882 (as *Calothrix pulvinata* in Wittr. & Nordst., Alg. Exs. 575); Arromanches, Calvados, *herb.* LEBEL, *herb.* DE BREBISSON; Banyuls, FLAHAULT, Oct. 10, 1886 (as *C. crustacea* in Wittr. & Nordst., Alg. Exs. 855a); Brest, *herb. Mus. Paris;* Moulin Blanc près de Brest, A. TAUGUY, Sept.; Cannes, A. RAPHÈLIS, Aug. 1927 (as *C. scopulorum* in Hamel, Alg. de France 52); Grande Ile Chansey, P. FRÉMY, Aug. (as *C. pulvinata* in Hamel, Alg. de France 10); Cherbourg, G. THURET, July 24, Aug. 19, 1874, K. VON NÄGELI, Sept. 1861, A. LE JOLIS (as *Schizosiphon lasiopus* and *S. Lenormandi* in Rabenh., Alg. Eur. 2129, 2130); Deauville, Manche, FRÉMY, Sept. 5, 1931 (as *Calothrix crustacea* in Hamel, Alg. de France 155); Le Croisic, E. BORNET & C. FLAHAULT, Sept. 21, 1887 (as *C. Contarenii* in Wittr. & Nordst., Alg. Exs. 853), Oct. 1, 1887 (as *C. crustacea* in Wittr. & Nordst., Alg. Exs. 855b); Le Fret, Finistère, A. TAUGUY, Aug. 16, 1885; Nacqueville et Omonville, L. CORBIÈRE, Aug. 20, Sept. 20, 1908; St. Malo, G. THURET, July 13, 1872; St. Marc, Laninon, Finistère, TAUGUY, Aug. 18, 1886. **Portugal** : Setubal, F. WELWITSCH *325*, 1842-1850 (D).

Bermuda : Shelly Bay, F. S. COLLINS, May 4, 1912 (as *C. scopulorum* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1856); Gravelly Bay, A. B. HERVEY, Jan. 8, 1913 (as *C. fusco-violacea* in Coll., Hold & Setch., Phyc. Bor.-Amer. 2060). **Newfoundland** : Bay of Islands, M. A. HOWE *870*, Aug. 10, 1901 (D); Big Barachois, Placentia Bay, H. J. HUMM *1*, Aug. 12, 1948. **Quebec** : Kegashka River, Saguenay county, J. BRUNEL *735, 738*, Aug. 26, 1939; Ile du Phare, St. Mary's Islands, J. BRUNEL *719*, 722, Aug. 24, 1939. **Prince Edward Island** : Cavendish, T. A .& A. STEPHENSON *PEC24*, July-Sept. 1948. **Nova Scotia** : Peggy's Cove, STEPHENSON *NSP1, NSP24*, July-Sept. 1948; Inner Sambro Island, Halifax, R. D. WOOD & C. MACFARLANE *53-7-14-13*, July 14, 1953. **Maine** : Lobster Point, Ogunquit, H. CROASDALE, July 10, 1937 (D); Eastport, W. G. FARLOW *1877* (D); Cape Rosier, F. S. COLLINS *3218*, July 17, 1895 (as *C. fasciculata* in Coll., Hold. & Setch. Phyc. Bor.-Amer. 261); Eagle Island, COLLINS *2112*, Harpswell, COLLINS *4510, 5297*, July 1902, 1905; Otter Creek, Mount Desert Island, COLLINS July 1900 (as *C. aeruginea* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 804); Appledore Island, R. D. WOOD *1*, July 29, 1952; Northport, York Island, COLLINS *1016, 2940;* South Harpswell, COLLINS, July 17, 1902 (as *C. pulvinata* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 957b). **New Hampshire** : Newcastle, M. DOTY & J. NEWHOUSE *7829*, July 9, 1951.

Massachusetts : Cohasset, COLLINS *4258;* Cuttyhunk Island, W. J. V. OSTERHOUT, Aug. 13, 1895, COLLINS, E. T. MOUL *6072*, July 23, 1948;

Sconticut Point, Fairhaven, F. DROUET *1882*, *1195*, E. D. HOFFMAN & DROUET *2241*, M. T. SIEGEL & DROUET *2242*, July 1934, 1936, 1938 (D); Falmouth, DROUET, July 5, 1937 (D), R. N. WEBSTER, J. C. STRICKLAND & DROUET *2121*, WEBSTER & DROUET *2153*, D. H. LINDER & DROUET *2249*, June-Aug. 1938 (D); Gay Head, M. POOLE, July 22, 1936 (D); Magnolia, W. G. FARLOW; Marthas Vineyard, DROUET *2166*, Aug. 25, 1937 (D); Marblehead, COLLINS, Aug. 27, 1895, June 1, 1901 (as *C. vivipara* and *C. scopulorum* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 560, 805); Mattapoisett, COLLINS, Oct. 20, 1906 (as *C. crustacea* f. *simulans* in Coll., Hold & Setch., Phyc. Bor.-Amer. 1406); Nahant, FARLOW (D), COLLINS, June 23, 1883, COLLINS *4625*, May 9, 1903; Madaket, Nantucket Island, B. F. D. RUNK. June 26, 1935, July 3. 1938, C. M. PALMER. Aug. 15, 1937 (D); No Mans Land, E. T. MOUL *6402*, July 29, 1949; Oak Bluffs, A. RUTLEDGE & DROUET *2246*, Aug. 2, 1938 (D); Penikese Island, DROUET *2138*, *2135*, Aug. 18, 1937 (D), W. R. TAYLOR, July 18, 1929, July 15, 1931, M. S. DOTY *6952*, *6952a*, *6956- 6958*, July 1947, *7278- 7280*, Aug. 3, 1947, DOTY, GAGE & BOYLE *7018a*, *7294*, *7296*, TAYLOR, WOOD & FAHEY *7302*, Aug. 3, 1947; Revere Beach, COLLINS, Sept. 29, 1895 (as *C. fasciculata* f. *incrustans* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 561), COLLINS *4654*, *4661*, May 1904; West Falmouth, COLLINS, Aug. 12, 1883; Woods Hole, A. J. BERNATOWICZ *191*, Aug. 17, 1950, H. C. BOLD, Aug. 7, 1954 (D), M. DOTY *6650*, July 20, 1947, W. R. DUDLEY, July 1876, E. M. FAHEY, Apr. 7, 1951, FAHEY *12271*, Nov. 23, 1952, FARLOW (as *C. crustacea* and *C. pulvinata in* Farl., Anders. & Eaton, Alg. Exs. Am. Bor. 49, 50), B. LIVINGSTON, Aug. 1875 (D), W. R. MAXON *11142*, Aug. 5, 1908. MOUL *6071*, July 22, 1948, C. P. NOTT (as *C. fusco-violacea* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 217), RUNK, July 4, 1941, W. A. SETCHELL, 1891-95, SETCHELL *779*, Aug. 5, 1894, SETCHELL, 1891 (as *C. vivipara* in Wittr. & Nordst., Alg. Exs. 1307b), W. R. TAYLOR, June 20, 1941, M. THURLOW, July 17, 1936 (D).

Rhode Island : Napatree point, D. C. EATON, Sept. 2, 1874; Block Island, DROUET *3655*, *3658*, *3659*, *3660*, July 13, 1941. **Connecticut** : Bridgeport, L. N. JOHNSON *807*, *1077*, July 29, *1892*, July 1, 1895, I. HOLDEN; East Bridgeport, JOHNSON *142*, July 14, 1892; Groton, SETCHELL, July 3, 1888; Thimble Islands, D. C. EATON, 1872; Woodmont, JOHNSON *823*, Aug. 6, 1892, HOLDEN, July 16, 1892 (as *C. crustacea* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 10). **New York** : Cold Spring Harbor, JOHNSON *1036*, *1078*, July 18, 1894, July 1895. **New Jersey** : Perth Amboy, F. WOLLE, July 1878 (as *Mastigonema velutinum* in Wittr. & Nordst., Alg. Exs. 388); Atlantic City, J. E. PETERS, May 14, 1891, COLLINS *2092*, May 1891. **Maryland** : Sandy Hill Beach, Tyaskin district, Wicomico county, P. W. WOLLE & DROUET *2253*, Aug. 21, 1938 (D). **Virginia** : York river east of Croaker, J. C. STRICKLAND *48*, Apr. 22, 1938 (D), at Queens Creek, A. F. CHESTNUT & STRICKLAND *1224*, July 27, 1942. **North Carolina** : Beaufort, H. L. BLOMQUIST *13697*, *13700*, June 1945, H. J. HUMM, Aug. 21, 1944, Apr. 7, Sept. 15, 21, 1947, HUMM & C. S. NIELSEN *1733*, *1734*, Aug. 8, 1949, NIELSEN *1632*, Aug. 5, 1949, T. A. & A. STEPHENSON *BS14*, Apr. 14-May 27, 1947, L. G. WILLIAMS, June 16, 1947; Wilmington, HUMM, Aug. 25, 1946; Wrightsville Beach, HUMM, May 24, 1946.

Florida : Apalachicola, DROUET & NIELSEN *10979*, Jan. 16, 1949; Alligator Point, « JACK *F.* », July 27, 1952; Cutler, HUMM, Jan. 10, 1946;

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Jacksonville Beach, HUMM 2, Mar. 19, 1948; Marco Island, P. C. STANDLEY *92840a*, Mar. 14, 1946; Marineland, T. A. & A. STEPHENSON *MIB*, *MIBa*, Mar. 20-29, 1947; Palm Beach, DROUET & H. B. LOUDERBACK *10204-10206*, Dec. 24, 1948; Panama City, DROUET & NIELSEN *10918*, *11609a*, Jan. 15, 30, 1949; Singers Island, east of Riviera, DROUET & LOUDERBACK *10231*, Dec. 25, 1948; Spanish Harbor Key, R. N. GINSBURG *BII*, Apr. 1952; St. Mark's lighthouse, Wakulla county, DROUET & G. MADSEN & D. CROWSON *11760*, *11761*, Feb. 1, 1949; St. Marks wildlife refuge, Wakulla county, NIELSEN & CROWSON, May 1949, NIELSEN, Oct. 4, 1951 (D). **Alabama** : Point Clear, DROUET & LOUDERBACK *10162*, Dec. 20, 1948. **Mississippi** : Bay St. Louis, DROUET *9815*, *9816a*, *9860*, Dec.8, 9, 1948; Biloxi, DROUET *10000*, *10002*, *10005*, DROUET & A. J. BAJKOV *10041*, *10047*, Dec. 1948; Ocean Springs, DROUET & R. L. CAYLOR *9893*, *9894*, Dec. 12, 1948. **Washington** : Orcas Island, N. L. GARDNER *2365*, Aug. 1910; San Juan Island, GARDNER *6094*; Whidbey Island, GARDNER *303*, Aug. 22, 1899 (as *Calothrix pulvinata* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 957a).

California: : Alameda, GARDNER, Jan. Apr., 1, 1904 (as *C. crustacea* and f. *prolifera* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1168, 1212); Balboa Beach, GARDNER & G. R. JOHNSTONE *7116*, Dec. 28, 1932, G. J. HOLLENBERG *1552*, Feb. 13, 1934; Carmel Bay, Mrs. LEIGHLEY, Jan. 1931, GARDNER *3126*, *7278*, Dec. 1915, May 9-18, 1933; Corona del Mar, HOLLENBERG *2139*, Oct. 24, 1937 (D), HOLLENBERG *2304*, June 1, 1938; Fort Boss, SETCHELL *1713*, Dec. 22-23, 1897; La Jolla, T. A. STEPHENSON *JBN41*, 1947; culture, La Verne, HOLLENBERG *2647*, May 27, 1939; Point Carmel, SETCHELL, June 10, 1901 (as *C. pilosa* in Coll., Hold. & Selch., Phyc. Bor.-Amer. 859); Point Lobos, Monterey county, GARDNER *3402*, May 1916, T. A. & A. STEPHENSON *PGL13*, Aug.-Nov. 1947; San Francisco, GARDNER *3690*, *4782*, *7274*, *7412*, Mar. 31, 1917, Mar. 25, 1922, May 9-18, July 12, 1933; San Pedro, GARDNER, Dec. 1906, June 1908, Jan. 1913 (as *C. scopulorum*, *C. crustacea* and *C. vivipara* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1720, 2104, 2105), HOLLENBERG *1579*, Oct. 3, 1936; Santa Catalina Island, E. Y. DAWSON *5661*, Nov. 30, 1948; Santa Cruz, H. E. & S. T. PARKS *6*, Feb. 1928; Seal Beach, HOLLENBERG *1543*, Oct. 3, 1936.

Bahama Islands : Bimini Island, H. J. HUMM *6*, 11. Mar. 28, Apr. 2, 1948; Hog Island, Nassau, M. A. HOWE *3369*, Jan. 25, 1905 (D). **Puerto Rico** : Boca de Congrejos, H. L. BLOMQUIST *12509a*, Jan. 27, 1942; Culebra Island, M. A. HOWE *4277*, Mar. 5, 1906 (D); Guanica bay, BLOMQUIST *13013*, Mar. 31, 1942; Santurce, San Juan, HOWE *1840*, *2001*, May 15, 21, 1903 (D), May 1903 (as *C. contarenii* in Coll., Hold. & Setch., Phyc. Bor.-Amer. 1113). **Barbados** : Hasting's Rocks, A. VICKERS, Jan. 7, 1899. **Netherlands West Indies** : Punta Basora, Aruba Island, W. R. TAYLOR *39-339*, *39-340*, Apr. 10, 1939. **Haiti** : south of Dame Marie, H. H. BARTLETT *17841*, May 1, 1941. **Jamaica** : Fort Clarence near Kingston, HOWE *4654*, *4655*, Dec. 21, 1906 (D); Ocho Rios, V. J. CHAPMAN, Apr. 1954 (D); Gun Cay off Port Royal, CHAPMAN *2a*. **Mexico** : Campeche Banks, S. SPRINGER, Aug. 27, 1951 (D). **Baja California** : Ensenada, GARDNER *4986*; Guadalupe Island, DAWSON *4074*, *4107*, *8152*, *8166*, *8201*, *8212*, *8333*, *8623*, Aug., Dec. 1946, Dec. 1949, P. C. SILVA, Feb. 1, 1950; Bahia de Santa Rosalia, DAWSON & D. FORK *1398*, 1479,

Apr. 1946; San José del Cabo, DAWSON *3238*, Nov. 7, 1946. **Sonora** : Bahia Kino, DROUET & D. RICHARDS *2899, 2901, 2902*, Nov. 10, 1939; Guaymas, DROUET & RICHARDS *3371*, Dec. 21, 1939; Puerto Lobos, Bahia Tepoca, DAWSON *814*, Feb. 19, 1946. **Costa Rica** : between Río Sándoval and Río Tigre, C. W. DODGE *4537*, May 1, 1930 (D); Río Sándalo, DODGE *10208*. **Brazil** : Caiobá, and Guaratuba, Paranâ, A. B. JOLY *490, 523*, Feb. 8, 12, 1951; Ilha do Sai, Paranâ-Santa Catarina, JOLY *580*, Feb. 14, 1951; Angra dos Reis, Rio de Janeiro, JOLY *252*, July 16, 1950; Itanhaen, São Paulo, JOLY *453*, Jan. 2, 1951.

Hawaiian Islands : Laupahoehoe, Hawaii, W. A. SETCHELL *5284*, July 24, 1900; Pahala Plantation beach, Hawaii, J. E. TILDEN, July 4, 1900 (as *Scytonema fuliginosum* in Tild., Amer. Alg. 629); Punaluu Landing, Hawaii, SETCHELL *10705*, Aug. 5, 1924; Hanauma bay, Oahu, W. J. NEWHOUSE *62*, May 3, 1953; Honolulu, M. S. DOTY *103, 9774, 9956*, 1952, NEWHOUSE *105*, Sept. 16, 1953; Kaena Point, Oahu, DOTY *8161*, Oct. 16, 1950; Kaneohe Bay, Oahu, NEWHOUSE *21*, Feb. 28, 1953; Kawela, Oahu, DOTY *8056, 8063*, Sept. 16-17, 1950; Kohuku, Oahu, DOTY *8921*, Oct. 27, 1951; Moku Manu, Oahu, DOTY *8450*, Nov. 24, 1950; Rabbit Island, Oahu, DOTY *8838*, Apr. 22, 1951. **Tuamotu Archipelago** : Otetou, Raroia Atoll, DOTY & NEWHOUSE *11320*, July 24, 1952. **Marshall Islands** : Kilange Island and Ine Island, Arno atoll, L. HORWITZ *9328, 9632*, Aug. 5, 19, 1951; Jieroru Island, Eniwetok atoll, W. R. TAYLOR *46-304a*, May 21, 1946; Kwajalein Island, Kwajalein atoll, G. J. HOLLENBERG *48-C1*, July 2, 1948. **Caroline Islands** : Metalanim district, Ponape, S. F. GLASSMAN *2301*, June 20, 1949. **New Zealand** : V. J. CHAPMAN; North Island, V. W. LINDAUER *1068;* Matanhi Bay, Bay of Islands, LINDAUER *658*, June 16, 1937; Hokianga river, North Island, CHAPMAN, June 1946; New Brighton, Otago, R. M. LAING *1776;* Bay of Islands, CHAPMAN *9060b*, summer 1947; Stewart Island, LINDAUER *6189, 8440*, June 3, 1945, Mar. 18, 1947, A. & V. K. NASH, Feb. 14, 1935 (as *C. aeruginea* in Tild., So. Pacific Pl., 2nd Ser., 618). **Japan** : Koiso, Maizuru Bay, I. UMEZAKI 37, Aug. 10, 1949 (D).

Philippines : Lubang Island, Mindoro, H. S. VILLAFLORES *31*, Sept. 11-17, 1935 (D); Puerto Galera, Mindoro, G. T. VELASQUEZ *795, 1043, 1930*, Apr. 12, 27, 1941, May 9, 1949; Calayan Island, Bahuyan Islands, R. C. MCGREGOR *30*, Sept. 30, 1903; Bungao, Tawi-Tawi, G. T. VELASQUEZ *3213*, May 10, 1952. **New Caledonia** : Anse Vata near Noumea, MRS. CATALA, Feb.-Mar. 1948. **Viet Nam** : Cauda, bay of Nhatrang, E. Y. DAWSON *11085*, Jan. 26, 1953; Binhcang north of Nhatrang, DAWSON *11394*, Feb. 26, 1953. **Indonesia** : Gisser, A. A. WEBER-VAN BOSSE, 1899-1900. **Australia** : New South Wales : Corrimal Headland, V. MAY *648*, Mar. 26, 1945; Cabbage Tree Creek, A. B. CRIBB *139-9*, Apr. 12, 1951. Queensland : Miami, Moreton Bay, and Noosa, CRIBB *O, R, P*, Jan. 4, 1949, Feb. 18, 1949, Jan. 1948. South Australia : Point Sinclair, H. B. S. WOMERSLEY *A14978*, Jan. 26, 1951; Myponga, WOMERSLEY *A12911*, Mar. 5, 1950; Point Westall, WOMERSLEY *A15029* Jan. 19, 1951; Mangrove Point, Spencers Gulf, WOMERSLEY *A15038*, Dec. 31, 1950; Kangaroo Island, WOMERSLEY *O, I, R, U, A7901, A10827y, A12664, A12894, A128899*, Jan. 1946-Jan. 1950, WOMERSLEY *A8201b, A9505e*, Jan. 1948; Port Willunga, WOMERSLEY *A16400*, Sept. 16, 1951. Tasmania : Southport, CRIBB *44-4*, Mar. 21, 1950; Port Arthur, CRIBB *38-2*, Mar. 7, 1950, CRIBB *116-26*, Jan. 23, 1951, CRIBB *149-18*, June 21, 1951, CRIBB *152-12*, June 29, 1951. Victoria : Paynesville, CRIBB *79-4*,

Source: MNHN, Paris

Oct. 2, 1950. Western Australia : Rottnest Island, M. H. JONES, C. M. CROSBY, Oct. 1934 (as *C. aeruginea* and *C. Contarenii* in Tild., So. Pacific Pl., 2nd Ser., 63, 85). Israel : Caesarea, T. RAYSS, Aug. 1941.

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Source MNHN Paris

The Laminaria Cycle

By F. T. WALKER
Institute of Seaweed Research, Musselburgh, Midlothian.

During the last ten years, 1946 to 1955, an extensive survey of the Laminariaceae growing around Scotland has been in continuous operation.

The whole of the marine coast of Scotland -- nearly 6000 miles — has been photographed (though the co-operation of the Royal Air Force and the Air Cover Library, Edinburgh) and, with the aid of these aerial steroscopic photos, quantitative assessments of the Laminariaceae have been made using ecological factors which the data, collected from detailed surveys, have revealed. Detailed surveying was operated from motor boats chartered from the fishing fleet and worked during all months of the year, using methods of quadrat sampling with calibrated spring-grabs.

Over widely separated localities on the north-east, north-west, south-east and south-west mainland of Scotland and the Orkney Islands, 86 detailed surveys have been completed since 1946 and of these more than half have been resurveys.

It has become obvious in the later phases of this research, that changes in the Laminariaceae, both in quantity and species, do occur over periods of time and it is now possible to indicate the probable trend.

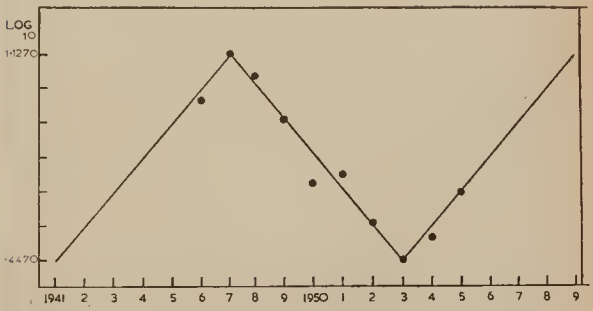

Fig. 1. — The Laminaria-cycle.

By far the greater quantity of the Laminariaceae was found between one and five fathoms (1 fathom = 1.85 metres) and was comprised of three species, mamely, *Laminaria cloustoni* Edm., *L. saccharina* Lamour. and *L. digitata* Lamour.

The mean fresh weight per unit area of these algae, found at fathom intervals of depth from 1 to 5 fathoms, from all surveys in each calander year from 1946 to 1955 was;

lb./sq. yard (× 0.54 for conversion to kg./sq. metre).

1946	9.1
7	13.4
8	11.2
9	8.0
1950	5.0
1	5.4
2	3.7
3	2.8
4	3.4
5	4.7

When these values (expressed as $\log_{10}$) are plotted on a graph whose crest is $\log_{10}$ 1.1270 and trough is $\log_{10}$ 0.4470 and whose regression is $\log_{10}$ 0.1133 per annum, then the trend of laminarian growth and reproduction over the last ten years will be seen, (figure 1).

Extrapolation of the *found* values backwards in time, will give a trough in 1942 similar to that recorded in 1953, and forwards in time will give a crest in 1958 similar to that recorded in 1947; both cases cover an eleven-year period. Ecological factors making for an eleven-year cycle appear to be controlling the Laminariaceae around Scotland. This conclusion is supported by data provided by 100,000 quadrats taken from the seabed over 67,000 acres (27,000 hectares).

It would be of interest to establish this eleven-year cycle by continuing the sub-littoral survey of the Laminariaceae of Scotland and at the same time seeking the causes.

The development and progress of the above survey are reported in the following published papers and official reports some of which have been sent to press while others have yet to go.

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Source : MNHN, Paris

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These reports were compiled separately and jointly by F. T. WALKER and W. D. RICHARDSON.

Haematococcus pluvialis and its Allies.
II. Nomenclature in *Haematococcus*.

By M. R. DROOP
(Marine Station, Millport, Scotland).

■

In a previous communication in this Journal (DROOP, 1956, fasc. 1/2), which discussed taxonomy within the family Sphaerellaceae, the name *Haematoccus pluvialis* was used without any reference being made to synonymy and nomenclatural confusion surrounding this species. Several attempts have been made in the last hundred years to clarify the situation, but even to-day there are three names in general use, viz., *Haematococcus pluvialis* Flotow em. Wille, *Sphaerella lacustris* (Girod-Chantrans) Wittrock, and *Haematococcus lacustris* (Girod-Chantrans) Rostafinski.

The following list of synonyms is compiled, in part, from HAZEN (1899) and, in part, from WILLE (1903) where more complete citations may he found: *Votvox lacustris*, Girod-Chantrans; *Lepraria kermesina*, Wrangel; *Sphaerella wrangelii*, Sommerfelt; *Protococcus nivalis*, Agardh em. Greville; *Haematococcus nollii*, Agardh; *Haematococcus grevillei*, Agardh; *Protococcus monospermus*, Corda; *Microcystis grevillei* (Ag.) Kützing; *Globulina kermesina*, (Wrang.) Turpin; *Disceraea purpurea*, Morren; *Protococcus cordae*, Meneghini; *Haematococcus pluvialis*, Flotow; *Protosphaera pluvialis*, (Flot.) Trevisan; *Protosphaera cordae*, (Menegh.) Trevisan; *Protococcus pluvialis* (Flot.) Kützing; *Chlamydococcus pluvialis*, (Flot.) Braun; *Hysginum pluviale*, (Flot.) Perty.; *Haematococcus lacustris*, (Girod) Rostafinski; *Sphaerella pluvialis*, (Flot.) Wittrock; *Sphaerella, lacustris*, (Girod) Wittrock.

No attempt is made here to give a complete bibliography for each of these synonyms. *Haematococcus pluvialis* Flot. em. Wille (1903) has been used extensively in physiological literature and was used by PASCHER (1927); *Sphaerella lacustris* (Girod-Chantrans) Wittrock was accepted by HAZEN (1899) and by WEST and FRITSCH (1926); and *Haematococcus lacustris* (Girod-Chantrans) Rostafinski has recently been revived by SMITH (1950).

An examination of the original diagnoses is necessary if an assessment of the relative merits of the various combinations is to be made. These will be taken in chronological order.

Source : MNHN, Paris

ORIGINAL DESCRIPTIONS

Volvox lacustris, Girod-Chantrans (1802), from Besançon, « développé spontanément dans une cuvette ». This is the first record of any organism which might be identical with *H. pluvialis* Flot. and, indeed, was so regarded by Rostafinski and Wittrock; but was thought not to be so by Cohn (1881) and Wille, on the grounds that it had been found in salt water, *H. pluvialis* being only known from fresh water. It was thought by these authors to be identical with *Euglena sanguinea* Ehr.

Girod-Chantrans gave little useful morphological information. The organism was motile, swimming « d'une vitesse médiocre avec un mouvement composé de rotation sur leur axe », which might refer either to *H. pluvialis* or *E. sanguinea*. No flagella were shown in the drawings; the shape was pear-shaped or more often exactly spherical, which description applies very well to *H. pluvialis* Flot. but not to *E. sanguinea* Ehr. The shape of the latter is more fusiform and at least four times as long as broad when swimming, though sluggish cells become blunter and, of course, the cysts are spherical. In addition, the drawings suggest *H. pluvialis* Flot. rather than *E. sanguinea* Ehr. in that there is a suggesion of the familiar relation between the protoplast and the cell-wall.

The behaviour as regards desiccation is suggestive of *H. pluvialis* and not *E. sanguinea*, for, in my experience, cysts of the latter species cannot be dried without loss of viability, whereas *Volvox lacustris* remained alive for four years in a dry state, and of course *H. pluvialis* is well known for its capacity in this respect.

Cohn's chief reason for rejecting *Volvox lacustris* was that he thought it had been found in salt water. There is nothing in the account to suggest this. Indeed, Besançon is many miles from the sea. Incidentally, Cohn's objection applies equally, or even more, to *E. sanguinea*. In point of fact, the typical habitat of *H. pluvialis* is well described by « cuvette », which suggests a small basin-like depression in rocks. Even if *Volvox lacustris* had been found near the sea there would be no great objection, since pools have been found with motile *H. pluvialis* within a fortnight of their being washed with sea wawes during a gale, and I have in my possession a frond of *Fucus vesiculosus* covered with viable *Haematococcus*-cysts. The only doubt in my mind lies in the fact that *Volvox lacustris* remained motile for three days in « eau commune imprégnée d'un douzième de muriate de soude », after which time the cells required to be put once more into fresh water before they would become active again.

Source: MNHN, Paris

The difficulty is the « douzième », which would seem to render the water some three times as salt as Atlantic water. Motile cells of *H. pluvialis* are killed if the salinity is raised above 6-8 ‰ and do not long remain motile at 4 ‰, but the cysts can survive many weeks in sea water (DROOP, 1955a). It is, however, possible that the correct interpretation of «un douzième de muriate de soude» is 1/12 part sea water, in which case the behaviour described would fit. *H. pluvialis* exactly.

Even if there is reasonable certainty that *Volvox lacustris* and *H. pluvialis* are synonymous, the diagnosis is scarcely good enough to warrant the adoption of *lacustris* as the specific name.

Lepraria kermesina, Wrangel (1823), from Verike, Sweden, as a powdery crust on limestone rocks. SOMMERFELT (1824) renamed this alga *Sphaerella wrangelii* giving it the following diagnosis : « *Vesiculis in crustam pulverulentam aggregatis* (*ad rupes inund. calc.*) *sanguineis* ».

When portions of this plant, which WRANGEL considered to be a lichen, were placed in sunlight in water, swarmers appeared after three days. After a time these came to rest again and on re-drying resembled the original material. Re-application of moisture resulted in the reappearance of the swarmers (*).

Again there is insufficient description, although WRANGEL may well have been observing *H. pluvialis*. In the generic diagnosis of *Sphaerella* Sommerfelt gives : « *Vesiculis gelatinosae globosae minutissimae* », and for the other species, *S. nivalis* : « *Vesiculis dispersis* (*in nive*) *punctiformibus sanguineus* ». The conception of the « *vesicula gelatinosa* » introduced here is rather unfortunate as it leads to confusion with encapsulated and palmelloid algae. Moreover, it is difficult to reconcile with « *in crustam pulverulentam* ». It is unfortunate also that SOMMERFELT should have ignored the diagnostically more useful characters, these concerning the motile stage, in order to align *Lepraria kermesina* with *Sphaerella nivalis* about which less was known.

Protococcus nivalis, Agardh (1824). Generic diagnosis : « *Globuli aggregati non mucosi, terrestres* ». Specific diagnosis : « *Globulis sanguineis sphaericis inaequali magnitudae, ad nives Alpinum Italiae, Gallea, Helvetiae, Norvegiae, Americae borealis, ad lapides calcarios Sueciae temperatioris.* » From these diagnoses it is not clear that the alga here referred to is identical with *S. nivalis*

(*) I have not had access to the original paper by WRANGEL. This account is taken from GREVILLE (1826).

Source: MNHN Paris

Somm., the one being « *globuli non mucosi* » and the other « *vesicalis gelatinosae* ».

GREVILLE (1826) amended AGARDH's diagnoses as follows, for the genus *Protococcus* : « *Globuli aggregati, nudi, granulis farcti, in gelatina hyalina imposita* »; and for the species *P. nivalis* : « *Globulis exacte sphaericis, minutissimis, vivide purpureis; gelatina patlida expansa* ».

This description is based on an alga found on the island of Lismore, Scotland, « on the borders of the lakes of Lismore, spreading abundantly over the decayed reeds, leaves, etc. at the water's edge; but in greater perfection on the calcareous rocks within the reach of occasional inundation; more or less perfect at all seasons of the year ». It was this alga which AGARDH (1828) gave the name *Haematococcus grevillei* and which WILLE (1903) considered synonymous with *H .pluvialis* Flot.

Of the gelatinous substratum GREVILLE writes « expanded, shapeless, without any defined border, colourless, various in thickness; sometimes thinner, sometimes thicker than the globules. On this substance the globules are sessile or very slightly sunk, never immersed ». If this gelatinous substratum is indeed part of the organism and not adventitious there can be no doubt that *H. pluvialis* Flot. is not concerned. No motility was shown by this alga, for « When mature they burst, and the internal granules escape, to the numbers 6-8 or more,..... The granules are globose, and escape one by one, or by several at once adhering together. Though I never could observe the least voluntary motion among any of these bodies,..... » Certainly if *H. pluvialis* Flot. had been involved motility would have been observed under these circumstances. The habitat, also, argues against it being *H. pluvialis*, as this species is seldom, if ever, to my knowledge, to be found in water supporting phanerogamic vegetation (DROOP, 1953).

Haematococcus noltii, Agardh (1828). « *Globulis elliptico sphaericis sanguineus, includentibus granula conferta numerosa. In stagnis turfosis tempore verno* ». AGARDH believed this form to be identical with *Lepraria kermesina* Wrang., though WILLE though it more probable that in reality it was *Euglena sanguinea* Ehr. AGARDH writes « Au lieu de globules simples, ils étaient remplis d'une quantité d'autres plus petites », and his drawings suggest a true palmella rather than cysts. As with the previous species the habitat, « une tourbière », does not support the view that *H. noltii* is synonymous with *H. pluvialis* Flot.

Protococcus monospermus, Corda (1833). There is scarcely any description attached to this note; but the drawings may be of *H. pluvialis* cysts.

Disceraea purpurea, Morren (1841b). Generic diagnosis : « *Animal e familia Cryptomonadinarum, lorica continua obvolutum, sphaerica, hyalina, corpora sphaerico aut ovoideo, autice attenuato, vesicatis viridibus rubis-ve, purpureis-ve internis repleto; probiscoidibus duobus longis instructum* ». Specific diagnosis : « *Corpore sphaeroideo, ovato, autice attenuato, lorica sphaerica, 3/100 mm. partem adaequante; probiscoidibus 4/100 mm. longis hyalinis* ».

This organism was found at Angers « dans une fiole et une assiette exposées pendant tout un hiver à la pluie ». The drawings agree well enough with *H. pluvialis* Flot. The cell is shown with a central nucleus of haematochrome and a green periphery, and the widely spaced cell-wall is plain. One drawing shows what is obviously a very recently formed cyst with the radial protoplasmic strands still visible; no strands are shown with the motile cells. This is interesting, on account of these strands, in *H. pluvialis,* often being most easily visible during encystment. Encystment is described « Alors la partie rouge grossit, se développe sans cesse et enfin, au moment où l'animal se fixe de nouveau, elle occupe presque les deux tiers de l'animal..... A cette époque le globule continue à grossir, à se colorer de nouveau pour se reproduire ». There can be little doubt that *D. purpurea* Morren is synonymous with *H. pluvialis* Flot.; and was regarded so by Cohn (1850), Hazen (1899) and Wille (1903). To Morren goes the honour of first observing the flagella.

Haematococcus pluvialis, Flotow (1844); from rain pools in granite rocks. Although no diagnosis is given the organism is described in great detail and is well illustrated. The various morphological forms encountered, both in nature and in crude cultures, are classified, the cardinal categories being :

A. *Quiescens.*
B. *Agilis.*
. a. *Versatilis*
. b. *Porphyrocephalis.*

From the descriptions and illustrations, « *Quiescens* » corresponds to the encysted condition, « *Agilis* » to the motile condition, « *Versatilis* » being the vegetative phase and « *Porphyrocephalis* » the gametes. There has, in fact, never been any doubt as to the identity of Florow's alga.

Source : MNHN Paris

DISCUSSION

It will by now be apparent that the confusion is in great part due to diagnoses being frequently based entirely on non-motile stages which have since proved inadequate for differentiating between species. I do not believe any one would to-day be so rash as to guarantee to tell, merely on superficial morphological characters, isolated *Brachiomonas submarina* zygotes from cysts of *Chlamydomonas pulsatilla* or *Dysmorphococcus coccifer*, or zygotes of *Stephanosphaera pluviatis* or *Balticola droebakensis* (*) from cysts of *Haematococcus pluviatis*, or haematochrome-forming species of *Chlorococcum*, to mention only a few species.

For this reason the diagnoses of SOMMERFELT, AGARDH and GREVILLE leave one in doubt as to whether *Sphaerella* Somm., *Protococcus* (Ag.) Grev., or *Haematococcus* Ag., did, in fact include *Haematococcus pluvialis* Flot. Indeed, except for the fact that WRANGEL's alga was included by SOMMERFELT in *Sphaerella*, there is no indication that any of these genera included motile algae at all.

Very often more can be inferred from the description of the habitat. *H. pluvialis* Flot. is essentially a rain-pool species, shunning permanent water harbouring macroscopie vegetation, such as ponds, bog-pools, or lakes (DROOP, 1953). Therefore, inadequately described records from this type of environment should be regarded with extreme caution. It is, perhaps, not without significance that those records in which both motile and resting stages were observed were from small or ephemeral pools. In this category may be included, *Volvox lacustris* Girod-Chantrans, *Lepraria kermesina* Wrangel, *Disceraea purpurea* Morren, and *Haematococcus pluvialis* Flotow, of which the first and second are probably, and the third certainly, synonymous with the fourth.

If both *Volvox lacustris* Girod-Chantrans and *Lepraria kermesina* Wrangel are accepted, the correct combination becomes *Lepraria lacustris* nov. comb. since *V. lacustris* Girod-Chantrans does not belong in *Volvox* Linn. Acceptance of *Sphaerella lacustris* (Girod) Somm. as a combination implies an acceptance of *S. wrangelii* Somm., since otherwise there would be no reason to include GIROD-CHANTRANS' alga in *Sphaerella*. Because SOMMERFELT's diagnosis of *S. wrangelii* is less acceptable than Wrangel's description, the name for this plant should be *S. kermesina* nov. comb. if for some other reason *Lepraria* is not valid, otherwise the name should be the one given by WRANGEL, i. e. *Lepraria kermesina*, or, as above,

(*) Cf. DROOP, 1956.

Lepraria lacustris nov. comb. Only if *Lepraria* is invalid for some completely unconnected reason does the combination *Sphaerella lacustris* (Girod) Somm. become a possibility, and then subject to *Sphaerella* itself not being invalid for any other reason.

That the latter is invalid has been advocated by WILLE (1903) on the grounds that is was founded on the species *S. nivalis*, which, together with other snow algae, has since proved to belong to *Chlamydomonas*.

Protococcus Ag. would be invalid for the same reason as *Sphaerella*, so that, in the event of both *Lepraria* and *Sphaerella* being unacceptable, the choice would be *Discerea lacustris* nov. comb.

If *Volvox lacustris* Girod-Chantrans is not accepted as being a synonym, while *Lepraria kermesina* Wrangel is so accepted, the same arguments are applicable and the name then becomes *Lepraria kermesina* Wrang. or *Sphaerella kermesina* nov. comb. or *Disceraea kermesina* nov. comb.

If, on the other hand, *V. lacustris* Girod-Chantrans and not *L. kermesina* Wrangel is regarded as being synonymous with our alga then the name should be *Disceraea lacustris* nov. comb.

While, if neither are accepted, then CORDA's alga comes in for consideration, *Protococcus monospermus*, or *Protococcus* being unacceptable, *Disceraea monospernia* nov. comb. But if *P. monospermus* Corda is also not accepted as a synonym, then the only choice is *Disceraea purpurea* Morren.

Haematococcus Ag. does not enter into the discussion, since GREVILLE's alga was almost certainly something other than *H. pluvialis* Flot.

Much of this confusion can be resolved by a rigorous application of Articles 42 and 52 of the International Code of Botanical Nomenclature (LANJOUW, 1952). Insufficient description and no diagnosis render invalidly published :

Volvox lacustris, Girod-Chantrans, 1802.
Lepraria kermesina, Wrangel, 1823.
Protococcus monospermus, Corda, 1833.

while, though being validly published in accordance with Article 42, there is no certainly as to the identity of the form referred to in :

Sphaerella wrangelii, Sommerfelt, 1824.
Protococcus nivalis, (Agardh) Greville 1926.
Haematococcus nollii, Agardh, 1828.
Haematococcus grevillei, Agardh, 1828.

Source MNHN Paris

On the other hand, *Disceraea purpurea* Morren, 1841, is validly published in accordance with Article 42, while *Haematococcus pluvialis*, Flotow 1844, can be so considered in accordance with Article 52, and no doubt exists that the two are synonymous. *Disceraea purpurea* Morren has priority over *Haematococcus pluvialis* Flotow, and is, therefore, the correct name.

The question remains as to how far one is justified in introducing a hitherto unused combination, almost certainly on debatable evidence, merely for the sake of nomenclatural exactness? And yet, the latter demands that the current combinations *Haematococcus pluvialis, H. lacustris*, and *Sphaerellu lacustris* be abandoned.

Clearly the case justifies the application of Article 24 of the International Code. Conservation would certainly put an end to the state of confusion.

There remains to be considered which is the most suitable combination for conservation. WILLE (1903) advocated the retention of *Haematococcus pluvialis* Flot., on the grounds of usage, and I find myself in full agreement wiht this view, particulary since the great body of physiological literature deals with the alga under this name. In addition this combination has priority (as a combination) over the other two in current use.

EMENDED DIAGNOSES

The emended diagnosis given for *H. pluviulis* by WILLE (1903) is unfortunately inaccurate on two points. In the first place, he states « Kontractile Vacuolen und Stigma fehlen », which, as WOLLENWEBER (1907, 1908) has shown, is not true of *H. pluvialis* or any member of the Sphaerellaceae. Secondly, he gives the length of the gametes as 1-3.5 μ, whereas in reality their lenght usually lies between 5 and 10 μ (DROOP, 1956).

WOLLENWEBER'S (1908) corrections were in large part followed by PASCHER (1927), but this has again to be altered to exclude *Balticola* spp. (DROOP, 1956), and the dimensions given for cysts need to be increased to include those of Baltic strains of *H. pluvialis* which differ from other strains in the maximum size attained by the cysts.

Genus *Haematococcus* (Flotow non Agardh) emended and proposed for conservation :

Diagnosis : Monadae familiaris Sphaerellaceae Schmidle em. Wollenweber, tegumento sine pupillae antice; pontibus protoplasmatibus hyalinis, subtilissimis, non ramosis, chromatophorum non cupientibus; pyrenoidibus fere semper pluribus quam duobus; cel-

tulis sexualibus de cystis natis cylindricis aut ovatis aut sphaericis, postice rotundatis aut truncatis; cystis asexualibus sexualibusque existentibus; saepe et cystis et cellulis errantibus haematochromae praeditis. Per propergationem, cellulae acquiescentes, flagillis maternis objectis, divisione prime longditudine, sed deinde protoplasto per 90° revolvente.

Haematococcus pluvialis (Flotow) emended. *Diagnosis : Cellulae maturae ovatae, maximae 63 × 51 μ, flagellis longis quam longitudine cellulae per tegumentum angulo obtusissimo instructis; stigmate pallide, lineare, arcuati, 13 × 2 μ, a latere, locato; nucleo centrale; cystis sphaericis, maximis 30-35 μ (pro genere et pro re); cellulis sexualibus 5-10 × 2-8 μ.*

The neo-type proposed for the genu *Haematococcus* and species *H. pluvialis* as diagnosed above is strain 34/1a in the Culture Collection of Algae and Protozoa, the Botany School, Cambridge. Living cysts of this strain have been deposited with the curator of the collection.

Most of the other strains of *H. pluvialis* represented in this collection, eg. 34/1b, 34/1c, 34/1d and 34/1e, are indistinguishable from 34/1a; hut 34/1f (from Spitzbergen Is.) and 34/1h (from Finland) differ from each other and 34/1a in some small morphological and physiological details.

SUMMARY

An examination of the tangled state of nomenclature in *Haematococcus* (Sphaerellaceae, Volvocales) suggests that the correct synonym for *H. pluvialis* is *Discerea purpurea* Morren; expediency, however, advocates « conservation » of the more widely used synonym *Haematococcus pluvialis*.

Acknowledgments.

This and my previous paper in this Journal are based on part of a dissertation presented in the University of Cambridge for the degree of Doctor of Philosophy. I have pleasure in acknowledging much help and encouragement given me by my teacher, Professor E. G. Pringsheim.

The work was carried out during the tenure of a Liverpool University Studentship and later during my first year in the service of the Scottish Marine Biological Association.

Source MNHN Paris

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Note : an astarisk (*) marks citations not seen in the original.

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Errata : les grossissements indiqués dans l'article précédent sont à corriger ainsi :

p. 54. — fig. 1-4 : × 1300.
p. 56. — fig. 5-8 : × 1300.
p. 58. — fig. 9-11 : × 1300; fig. 12-18 : × 650.
p. 59. — fig. 19-20 : × 1300.
p. 61. — fig. 21-31 : × 2100.
p. 65. — fig. 32-36 : × 650.

MNHN Paris

NOTULES ALGOLOGIQUES

Cette rubrique réunit de courtes notes sans illustrations ni références bibliographiques. Elle permettra aux auteurs de publier des observations nouvelles ne se prêtant pas à un long développement, notamment celles concernant l'écologie ou la biogéographie des Algues, ou de prendre date avant la parution d'un travail plus complet.

■

Cellules basales atypiques chez les cyanophycées sans hétérocystes.

Dans un article intitulé « Morphologie de *Homeothrix balearica* (Born. et Fl.) *Lemm.* et fonction des hétérocystes chez les Algues bleues » (*Bull. Soc. Bot. Fr.*, 1948, 95, n° 7-9), j'ai eu l'occasion de signaler la forme toruleuse des cellules basales dans les filaments d'un *Homeothrix*. Ce caractère atypique s'accompagne d'étranglement du trichome au niveau des cloisons et donne aux cellules basales de la plante un aspect de rotules.

Des observations analogues m'ont été communiquées et montrent que ce fait n'est pas isolé.

M. G. E. Fogg (University College London) m'indique que lorsque *Gloeotrichia natans* est cultivé en présence de sels d'ammonium, les hétérocystes font complètement défaut (1), mais les cellules basales prennent la forme décrite plus haut.

M. Mabille (Berthenicourt) a récolté *Tapinothrix borneti* Sauv., et cet échantillon présentait également une cellule basale analogue à celle de *Homeothrix balearica*.

Cette réaction morphologique n'est donc pas rare, et on en trouverait certainement d'autres exemples. L'observation de M. Fogg est particulièrement instructive, car elle illustre directement l'hypothèse avancée pour interpréter ces formes atypiques. La cellule basale en forme de rotule est un équivalent mécanique de l'hétérocyste, rotule nettement différenciée pour jouer un rôle d'articulation. L'examen des cyanophycées hétérocystées permet fréquem-

(1) Cf. G. E. Fogg. — Growth and heterocyst production in Anabaena cylindrica Lemm. *Annals of Botang*, 1949, N. S. 13, 241-259.

ment d'observer que les liaisons trichomes-hétérocystes articulent parfaitement le trichome en plusieurs tronçons indépendants. Si ces maillons n'existaient pas, certaines membranes seraient soumises à des efforts qui provoqueraient leur rupture. Il est fort probable d'ailleurs que l'accroissement local de ces efforts déclenche la transformation d'une cellule normale en hétérocyste.

Le fait de voir se substituer dans une culture de *Gloeotrichia natans* les cellules basales en rotule aux hétérocystes typiques semblent justifier cette interprétation.

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■

Deux stations d'Hildenbrandia rivularis en Bretagne

En 1954, P. Bourrelly (1) donnait un aperçu des stations où l'on avait trouvé en France l'algue crustacée *Hildenbrandia rivularis* (Liebm.) Bréb. Il ressortait clairement de son article, que la distribution de cette Rhodophycée dans ce pays étaient encore imparfaitement connue. Aucune station par exemple n'était signalée en Bretagne. Pendant son séjour en juillet 1954 dans cette région l'auteur a pu découvrir deux stations *d'Hildenbrandia.*

La première est située à 3 km. de l'Ouest de Saint-Pol-de-Léon (Finistère), dans le petit ruisseau de l'Horn. Sous un viaduc, dans un petit rapide du ruisseau se développe une végétation luxuriante de *Lemanea fluviatilis* accompagnée aux endroits plus éclairés de touffes de *Cladophora glomerata.* C'est à cet endroit que croîssent sur le fond entre les tapis de *Pseudo chantransia chalybea,* quelques thalles rouge sombre d'*Hildenbrandia.*

La deuxième station a été trouvée dans une large rivière, d'environ 7 m., aux eaux un peu souillées, qui coule près de Belle-Isle-en-Terre (Côtes-du-Nord). La végétation se composait surtout de *Lemanea fluviatilis,* accompagnée en majeure partie par la mousse *Fontinalis antipyretica.* Nous y avons trouvé sur le fond, en abondance, *Hildenbrandia rivularis* et le lichen *Collema* spec. Le degré de recouvrement de la rhodophycée atteignait 25 %. Nous y avons également noté l'espèce accompagnatrice (2), le lichen *Verrucaria*

(1) P. Bourrelly. — Quelques stations françaises d'*Hildenbrandia rivularis* (Liebm.) Bréb. *Rev. Alg,* N.S.I.-3, p. 168-169, 1955.

(2) H. Luther. — Über Krustenbewuchs an Steinen fliessender Gewässer, speziell in Südfinnland. *Act. Bot. Fenn.* 55, p. 1-67, 1954.

Source : MNHN Paris

rheitrophila. Hildenbrandia y croissait surtout sur les côtés latéraux des pierres; dans les eaux profondes l'algue couvrait également le sommet des pierres. Dans la matinée cet endroit était éclairé par le soleil.

L'association à *Hildenbrandia* notée en Bretagne, s'écarte très fort de celle, qui se développe dans les petits ruisseaux, peu profonds et ombragés des Pays-Bas. Dans les bois de Bunde au Nord de Maastricht, *Hildenbrandia rivularis* et *Verrucaria rheitrophila* forment une association, rarement accompagné par des mousses (3).

Nous donnons, ci-dessous 2 relevés effectués dans les stations précitées de Bretagne. Nous les avons fait suivre d'un relevé typique établi dans une station hollandaise.

Relevé 1 : Dans l'Horn près de Saint-Pol-de-Léon; surface 2 m²; 23-VII-54; degré de couverture : 80 %.

Relevé 2 : Rivière près de Belle-Isle-en-Terre; surface 4 m²; 24-VII-54; degré de couverture : 80 %.

Relevé 3 : Petit ruisseau près de Bunde; surface 1 m²; 4-VI-55; degré de couverture : 35 %.

	1	2	3
Hildenbrandia rivularis (Liebm.) Bréb.	+	3	2
Verrucaria rheitrophila Zschacke		1	3
Lemanea fluviatilis Ag.	2	2	
Cladophora glomerata (L.) Kütz.	2	+	
Fontinalis antipyretica L.	1	2.3	
Platyhypnidium rusciforme (Neck.) Fleisch.	+	+	
Stigeoclonium tenue Kütz.	+		
Oedogonium spec.	+		
Rhizoclonium hieroglyphicum (Ag.) Kütz.	+		
Chantransia hermanni (Roth) Desv.	2		
Pseudochantransia chalybea (Fries) Brand	4		
Nostoc minutum Desm.		2	
Collema spec.		3	
Chiloscyphus cf. *polyanthus* (L.) Cord.		+°	
Scapania cf. *irriqua* (Nees.) Dum.		+°	

C. DEN HARTOG.
Hugo de Vries Laboratorium,
Amsterdam.

(3) C. DEN HARTOG. — Het Roodwier *Hildenbrandtia rivularis* in Zuid-Limburg. *Nat. Hist. Maandblad*, 43, p. 77-79, 1954.

Les Flagellés des eaux extrêmement acides

Pendant l'exploitation des tourbières aux places où l'on décharge les blocs de tourbe, prennent naissance des petits marécages dont l'acidité est très basse (pH 1-3). De telles eaux acides, découvertes dans les environs de Frantiskovy Lázne (Tchécoslovaquie) par Prat (1955) tirent leur origine du lessivage des sols tourbeux, contenant de la pyrite qui est oxydée en sulfates et en acide sulfurique. Le pH de ces habitats acides s'abaisse au-dessous de 1. Les premiers organismes autotrophes qui ouvrent la colonisation biologique de ces habitats encore vierges sont les flagellés. Les eaux à pH plus bas que 1 n'offrent que *Chlamydomonas applanata* Pringsheim var. *acidiphila*, variété nouvelle qu'on ne trouve pas dans les localités ayant un pH supérieur à 2. *Euglena mutabilis* Schmitz est bien connue comme étant un organisme habitant des eaux acides, même les eaux résiduaires des mines (Lackey 1939, Hein 1952). Elle a été observée cependant du pH 1 à 5. Dans les eaux dont l'acidité monte à pH 2, *Lepocinclis teres* (Schmitz) Francé forma *glabra* f. *nova* commence à coloniser les fonds des marécages. Ces organismes, qui supportent une forte acidité, jouent un rôle important, car ils diminuent l'acidité du milieu, et après leur dépérissement, ce milieu devient favorable au développement d'autres organismes moins acidophiles, Diatomées, Chlorophycées, Cyanophycées et même plantes supérieures.

La diagnose des nouveaux taxa, sera publiée ultérieurement dans « Preslia ».

Bohuslav FOTT (Prague).

MNHN Paris

BIBLIOGRAPHIE

Les conditions actuelles de l'imprimerie ne permettant plus d'envisager la parution d'une Bibliographie Algologique méthodique comme dans la première série de cette revue, il ne sera publié que des indications bibliographiques concernant les ouvrages importants ou les mémoires d'intérêt général. Les lecteurs de langue française peuvent trouver un complément d'information dans la « Bibliographie » paraissant en annexe au « Bulletin de la Société botanique de France » et dans le « Bulletin analytique » publié par le Centre National de la Recherche Scientifique.

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DELLOW Vivienne. — Marine Algal Ecologie of the Hauraki Gulf, New Zealand. (*Trans. Roy. Soc. New Zealand*, vol. 83, Part 1, pp. 1-91, June 1955).

Etude de l'écologie et de la répartition des espèces, dont 241 d'algues, dans ce golfe de quatre-vingt kilomètres de long, situé au Nord de la Nouvelle-Zélande.

Le substratum est assez varié, le vent et la pluie ont leur importance, ainsi que les courants. La poltution ainsi que l'agitation expliquerait la relative pauvreté de la flore.

La répartition verticale des espèces fait l'objet d'une discussion. L'auteur se réfère aux travaux de T. A. et A. STEPHENSON, sans essayer de trop subdiviser.

Quarante « Biotic communities », dont onze saisonnières, se rencontrent sur ces côtes, et se répartissent verticalement et horizontalement. — M. Dz.

WOMERSLEY H. B. S. — The species of Macrocystis with special reference to those on southern australian coast. (University of California publications in Botany, vol. 27, n° 2, pp. 109-132, plates 1-8, 1 map. 1954).

Monographie du genre *Macrocystis*. Les trois espèces admises ici comme seules valables, se différencient exclusivement par le système de fixation des frondes, d'où intérêt pratique pour les récoltes. Localement, l'extrémité des frondes peut être utilisée, sans que cela permette une clef dichotomique générale. La fronde est, en effet très polymorphe. Quant aux vésicules, elles ne représentent qu'une variation écologique.

L'espèce type du genre reste douteuse. L'échantillon d'herbier est incomplet, la localité des plus vagues.

Ce genre se localise entre 0 et 7 m., dans l'hémisphère Austral et sur la côte Pacifique de l'Amérique Nord. La carte donne la répartition des trois espèces, séparément. — M. Dz.

DREW Kathleen M. — The organization and inter-relationships of the carposporophyte of living Florideae. (Phytomorphology, vol. 4, n° 1, 2, March 1954, pp. 55 à 69).

Vue d'ensemble sur les aspects du développement de l'œuf chez les Floridées, avec le souci de termes bien définis. L'auteur renonce au « cystocarpe », car trop de définitions en ont été proposées. Il donne une définition des carposporophyte, gonimoblaste, cellule auxiliaire, et propose l'emploi de « gonimocarpe » pour remplacer un des sens de cystocarpe.

Le carposporophyte est très variable chez les Floridées. Aussi, après en avoir donné les caractères communs et les traits généraux, l'auteur classe les types actuellement connus, en montrant comment ils peuvent dériver les uns des autres. Il apparaît que les faits importants à ce point de vue sont les transferts de noyaux, l'étalement de la zone carposporigène ou inversement la production d'une fructification limitée dans l'espace, mais hautement différenciée.

Organisation du carposporophyte et classification sont ensuite confrontés. — M. Dz.

SVEDELIUS N. Are the haplobiontic florideae to be considered reduced types? (*Svensk Botanisk Tidskrift*, Bd 50, H. 1, 1956, pp. 1-24, fig. 1-14).

L'intérêt de la distinction des Floridés en haplobiontiques et diplobiontiques, ainsi que les relations qui unissent ces deux types ont été récemment remis plusieurs fois en question. Ceci dû évidemment à l'avancement de nos connaissances en ce domaine, bien incomplètes malgré tout.

La famille des Chaetangiacées présente plusieurs type d'alternance. L'auteur, qui l'a déjà étudiée à ce point de vue, présente ses observations sur la cytologie de *Gloiophloea, Pseudogloiophloea* Levring, *Pseudoscinaia,* et les compare avec ses observations antérieures sur *Scinaia.*

Si la méïose doit se faire de façon similaire chez ces différents genres, l'avenir des quatre noyaux n'est pas toujours le même. Dans le type *Scinaia,* trois dégénèrent, il ne se forme qu'un gonimoblaste. Mais chez *Pseudoscinaia,* les quatre subsisteront et il y aura de ce fait plusieurs gonimoblastes. Ce que l'auteur rapproche de ses observations parues en 1939 sur *Dermonema gracile,* qui conserve aussi les quatre noyaux.

Ces observations conduisent à définir le genre *Pseudoscinaia* sur d'autres caractères que ceux utilisés par SETCHELL et qui reposaient sur des faits mal interprétés.

Les caractères végétatifs sont aussi utilisés pour essayer d'établir une lignée évolutive.

Parti d'un souci phylogénique, l'auteur y revient dans sa conclusion, montrant en particulier que la découverte de l'absence de dégé-

Source : MNHN, Paris

nérescence nucléaire après méïose chez des algues voisines de celles qui présentent ce phénomène est intéressante pour l'établissement d'une ligne d'évolution. — M. Dz.

DREW Kathleen M. — Studies in the Bangioideae. III. The life-history of *Porphyra umbilicalis* (L.) Kütz. var. *laciniata* (Lightf.) J. Ag. A. The Conchocelis-phase in culture (*Annals of Botany*, N. S. vol. XVIII, n° 70, April 1954, pp. 183 à 211, 5 fig., pl. IX à XII).

Complétant des publications antérieures (1949), cette étude décrit le développement de *Porphyra* à partir des spores du thalle bien connu de tous.

Les spores de ce thalle et leur avenir, même immédiat, étant encore peu connus, l'auteur donne, après la littérature antérieure, les faits bien établis, puis ceux qui sont discutables ou qui ont été infirmés.

Les expériences de germination ont été faites avec du matériel provenant de la côte Ouest d'Anglesey. Après avoir distingué les différents types de spores rencontrés dans ses échantillons, l'auteur donne ses méthodes de culture. L'intérêt de ces méthodes réside en l'emploi de coquilles stérilisées, en place des classiques lames de verre.

En se développant sur coquille, les spores de *Porphyra* donnent un thalle filamenteux muni de cellules fertiles identique à celui de *Conchocelis rosea* Batters, qui doit donc être considéré comme simple phase d'un cycle. Cette conclusion a été duement vérifiée, avec témoins sur verre. On retrouve le même accroissement végétatif, les mêmes files de cellules fertiles, mais en plus des «plantules», disques plats de filaments naissants d'un centre pseudoparenchymateux, et de valeur encore impossible à affirmer. Ces plantules naissent de cellules fertiles ou de cellules végétatives du *C. rosea*.

L'auteur signale l'intérêt présenté par un cycle dont une partie se passe dans la zone intercotidale, une autre beaucoup plus profonde pouvant (semble-t-il) se continuer seule indéfiniement, accroissant ainsi les chances de survie de l'espèce.

Figures et photographies sont très démonstratives. — M. Dz.

CROASDALE H. — Freshwater Algae of Alaska. I. Some Desmids from the interior. (Part 1. *Farlowia*, 4 (4) p. 513-565, 1955; part 2. *Trans. Amer. Microsc.* Soc. 75 (1), p. 1-70 1956).

Dans ces deux notes l'auteur étudie une partie des Desmidiées (une troisième partie suivra) recueillies dans le centre de l'Alaska; il s'agit en général de formes de tourbières plates, subarctiques, à pH très près de la neutralité ou même légèrement alcalin. Cette région est excessivement riche en Desmidiées : le seul chapitre consacré au genre *Cosmarium* couvre une cinquantaine de pages. L'auteur nous donne un travail très complet de systématique critique illustré de 28 planches originales. Quelques espèces de *Closterium* et près d'une trentaine de

Cosmarium nouveaux sont décrits. Pour chaque espèce rencontrée, en plus de la station, le pH, l'altitude, le type de biotope (rochers mouillés, expression de mousse, fond de lacs, etc...) sont indiqués.

Signalons entre autre la découverte de quelques formes vivantes qui n'étaient connues en Europe que fossiles ou subfossiles.

Cet important mémoire est de plus une révision complète des travaux antérieurs sur cette région; nous avons donc entre les mains, une florule régionale actuellement à jour. — P. By.

FRIEDMANN I. — *Geitleria calcarea* n. gen. et n. sp. A new atmophytic lime-incrusting Blue-green Alga. (*Bot. Not.* 108, 4, 1955, p. 439-445).

L'auteur découvre un nouveau genre de Cyanophyeée subaérienne sur les rochers calcaires des grottes de Palestine. Il s'agit de filaments entourés d'une gaine fortement incrustée par des aiguilles de calcite.

La multiplication se fait par hormogonies. Il n'y a ni spores ni hétérocystes et pas de différenciation entre filament principal et rameau. Ce nouveau genre appartient à la famille des Stigonemataeées et se place au voisinage des *Nellicarteria* (= *Rosaria*) ou des *Doliocatella*. — P. By.

HIRANO M. — Freshwater Algae (in Fauna and Flora of Nepal, Himalaya, Scientific Results of the Japanese Expeditions to Nepal, Himalaya, 1952-1953, vol. 1) (Kyoto, 1955).

L'auteur étudie les florules algales de 11 stations s'échelonnant entre 630 m. et 4.000 m. d'altitude. Les Diatomées et les Desmidées sont les groupes dominants. Deux variétés de *Cosmarium*, deux de *Staurastrum* et une nov. sp. de *Chaetomnion* sont décrites.

Pour chaque algue l'auteur indique la distribution géographique mondiale. La plupart des Desmidiées rencontrées sont connues dans l'archipel Japonais et sont sans doute des cosmopolites. On reconnaît un élément Indo-Malais caractérisé entre autres par *Euastrum substellatum* et *Cosmarium javanicum*. Cette flore montagnarde est remarquable par le petit nombre d'*Euastrum* (4 espèces), de *Micrasterias* (une sp.), de *Pleurotaenium* (1 sp.) et de Desmidiées filamenteuses (1 sp.).

Signalons la présence de *Prasiola formosana* espèce connue de Corée et de Formose.

Huit planches dont une de microphotographie illustrent cet intéressant mémoire. — P. By.

LOPEZ J. — Variación alométrica en *Ceratium tripos* (*Inv. Pesq.*, II, 1955, Barcelona).

L'auteur étudie biométriquement les populations naturelles de *Ceratium tripos* de la côte espagnole méditerranéenne de la Province de Castellon. Il recueille à diverses périodes de l'année 94 tubes de planeton

Source : MNHN, Paris

et mesure environ un millier de *Ceratium*. Il prend dans chaque cas la longueur du sillon (diamètre de la cellule) et la longueur des 2 cornes droite et gauche. Il montre qu'il y a une relation linéaire simple, dont il donne la formule, entre la longueur de chaque corne et la longueur de la ceinture flagellaire.

Par contre les variations annuelles de la longueur du sillon s'expriment par une courbe à deux sommets qui indiquent qu'il y a deux populations indépendantes. L'une, à petites cellules, est abondante surtout en été, l'autre à grandes cellules existe toute l'année mais avec un minimum estival. La température n'a pas d'influence sur la longueur des cornes mais agit simplement sur l'abondance des individus.

Cette belle étude permet à l'auteur de conserver, pour la Méditerranée, deux variétés de *C. tripos* : *C. tripos* v. *pulchellum* et *C. tripos* var. *tripodioides* dont il précise les diagnoses. La variété atlantique qui n'a pas été étudiée, est conservée provisoirement.

Cet intéressant travail met un peu d'ordre dans la systématique des *Ceratium;* il faut espérer que l'auteur étendra ses recherches à d'autres espèces du même genre car le taxinomiste se perd dans un dédale de variétés et de formes dont la valeur aurait besoin d'être éprouvée.

P. By.

Pierre Dangeard. — Algues de la presqu'île du Cap-Vert. — *Le Botaniste* sér. XXXVI, p. 195-329, 11 fig. et pl. XIV-XXI, 1952.

Comme complément au travail du Pr Sourie que nous avons analysé ici même, nous croyons intéressant de signaler à nos lecteurs l'étude antérieure, particulièrement importante au point de vue systématique du Pr Pierre Dangeard sur les algues de cette presqu'île qui, nous le répétons, avait été peu étudiée jusqu'ici, comme en témoigne l'historique des recherches que l'on trouve en tête de ce mémoire.

Aprés avoir décrit brièvement la géologie de la presqu'île, P. Dangeard énumére les principales formations d'algues qu'il a rencontrées sur cette côte où le mode battu est dominant : coussinets de *Caulacanthus* et de *Gelidium*, ceinture de *Ralfsia*, Entéromorphes et Ulves sur les blocs plus abrités, *Laurencia obtusa*, *Gelidium arbusculus* et *Pterocladia capillacea* sur les rochers battus ; et aux niveaux les plus inférieurs : *Ecklonia Muratii*, *Cystoseira senegalensis* et *Sargassum vulgare*. L'Auteur souligne aussi la persistance jusqu'à Dakar d'éléments atlatiques tempérés : tels que les *Cystoseira*, *Gelidium* et *Rhodymenia palmetta*. C'est de la flore marocaine que celle du Cap-Vert se rapproche le plus.

Ce Mémoire, nous l'avons dit est surtout intéressant au point de vue systématique. En effet cette introduction est suivie du catalogue ou de la description, souvent avec figures, de toutes les algues que l'auteur a récoltées et dont un certains nombre sont nouvelles pour la science appartenant, aux genres : *Ulvella*, *Endogenes*, *Enteromorpha*, *Rhizeuteron*, *Cystoseira*, *Gelidium*, *Hypnea*, *Gymnogongrus*, *Ceramium*, *Pyconothamnion*, *Chondria*, etc...

A d. Davy de Virville.

Source MNHN

NYGAARD G. — The ancient and recent Flora of Diatoms and Chrysophyceae in Lake Gribsö (in Studies on the humic, acid Lake Gribsö par K. BERG et I. B. PETERSEN) (*Fol. limnol. Scandin.* 8, p. 32-94, 1956).

Dans une étude limnologique très documentée sur le lac Gribsö, l'algologue danois bien connu NYGAARD a étudié les carottes de sondages prélevées dans le fond du lac. Ces carottes ont montré une excellente conservation des Diatomées et des kystes siliceux de Chrysophycées. L'étude quantitative des Diatomées rencontrées permet de retracer l'histoire géologique du lac et la palynologie donne une chronologie comparative fort précise. La comparaison de la flore diatomique fossile des sédiments du lac, avec la flore actuelle des lacs de Scandinavie permet d'avoir des précisions sur l'histoire des biotopes qui se sont succédés; on peut même indiquer les pH successifs de l'eau en faisant les rapports entre espèces acidophiles et alcalinophiles. Ce lac vers 3.000 avant J.-C. était alcalin. Puis vers 400 avant J.-C. il passe à la neutralité et commence à s'acidifier fortement pour atteindre un pH très bas (environ 5) en 400 après J.-C. Puis nouveau changement, alcalinisation, et à partir de 1.800 reprise de l'acidification jusqu'à nos jours.

Cette intéressante étude est complétée par de précieuses notes systématiques sur les Diatomées avec description d'espèces nouvelles particulièrement pour le genre *Melosira*. L'écologie de diverses espèces de *Melosira* planctoniques est examinée avec soin.

Enfin l'auteur figure et décrit 77 kystes siliceux de Chrysophycées trouvés dans les sédiments du lac. Une série d'observations d'écailles de *Mallomonas* au microscope électronique termine la partie algologique de ce mémoire qui est illustré par 12 planches se rapportant aux Diatomées et aux kystes de Chrysophycées. — P. By.

SERPETTE M. — Contribution à l'étude des Cyanophycées de l'Afrique occidentale (*Bull. I.F.A.N.*, XVII, sér. A, n° 3, 1955).

L'auteur a recueilli et étudié les échantillons de Cyanophycées de la région de Bamako (Soudan français). Il y reconnaît 55 unités systématiques dont 3 nouveautés; 10 espèces sont nouvelles pour l'Afrique. Il nous donne d'intéressantes remarques sur l'écologie des Cyanophycées et indique les formes caractéristiques des divers biotopes étudiés : aérophile, rhéophile, limnophile. Le pourcentage des espèces à répartition intertropicale s'élève à 27 %, il faut y ajouter 11 % de formes strictement africaines. Il retrouve assez fréquemment en habitat subaérien le *Tolypothrix Roberti-Lamii* que nous avions découvert à la Guadeloupe. De même il rencontre au Soudan un certain nombre d'espèces d'Asie méridionale (Indes, Ceylan, Insulinde).

L'auteur a l'impression qu'un cosmopolitisme intertropical se dégage de ces observations.

Source : MNHN Paris

Une étude systématique très précise complète ces notes écologiques et biogéographiques illustrées par 29 figures d'espèces intéressantes.

P. By.

STARR R. C. — A comparative study of *Chlorococcum Meneghini* and other spherical, zoospores-produeing genera of the Chlorococcales. (*Indiana Univ. public. sc. ser.* n° 20, 111 p., 1955).

L'auteur, se fondant sur les cultures unialgales, nous donne une uonographie du plus haut intérêt sur les Chlorococcales à zoosporulation et à cellules sphériques appartenant aux genres *Chlorococcum*, *Radiosphaera*, *Dictyococcus*, *Bracteacoccus*, *Spongiochloris* (nov. gen.), *Dictyochloris*, *Trebouxia*, *Neochloris* (nov. gen.), *Nautococcus* et *Planktosphaeria*. Il s'agit là d'un ensemble de genres très voisins dont la taxionomie est particulièrement délicate et la synonymie fort complexe. Chaque genre est défini d'après la structure du plaste et la morphologie de la zoospore. On distingue 5 types de structure du chloroplaste : sphère pariétale creuse, plaste axial, plaste étoilé, plaste réticulé, et nombreux plastes pariétaux. Les zoospores forment 3 séries suivant la présence ou l'absence de membrane, l'égalité ou la légère inégalité des 2 flagelles :

1) zoospores chlamydomonadiennes à fouets égaux et membrane;
2) zoospore nue à fouets égaux du type *Prolosiphon;*
3) zoospore nue à fouets légèrement inégaux du type *Bracteacoccus*.

Pour chaque genre, l'auteur donne une diagnose complète, une série de figures originales et la description des espèces connues ou nouvelles appartenant au genre décrit. Un index de trois pages avec les nombreux synonymes, facilite les recherches. La bibliographie, fort complète, présente pourtant une lacune importante. L'auteur n'a pas eu sous la main le travail de GEITLER sur *Nautococcus*, travail où est décrit le genre *Nautococcopsis* (*Biolog. gener.*, 16, 4, p. 460, 1942).

Cet intéressant mémoire, illustré par 239 figures, est particulièrement précieux et utile pour le systématicien, car la clarté du texte, des figures et des clefs dichotomiques permettront la détermination facile de ce groupe de chlorophycées unicellulaires si commun dans les cultures et si délicat à reconnaître.

P. By.

TAYLOR W. R. — Crytogamic flora of the Arctic. II Algae : non planktonic (*Bol. Bev.*, 20 (6-7), pp. 363-399, 1954).

L'auteur nous donne une synthèse de nos connaissanees sur les algues des régions arctiques, tant marines que d'eau douce avec une très abondante hibliographie (Diatomées et planeton exclus).

Il indique, pour les algues marines, les divers facteurs contrôlant la végétation : lumière, température, topographie et substrat, salinité. Puis

Source : MNHN Ex

il passe en revue et caractérise rapidement les flores marines des diverses régions arctiques. Il conclut par une citation de KJELLMAN disant « que les traits dominant de l'aspect général de la flore marine arctique sont: rareté des individus, monotonie et luxuriance ».

Les algues d'eau douce sont traitées dans le même esprit de synthèse. Il donne une place importante à la cryovégétation des neiges colorées et aux Cyanophycées (*Gloeocapsa* et *Nostoc*) vivant sur le sol et les rochers mouillés. Les eaux vives sont caractérisées par l'abondance de *Prasiola fluviatilis*. Dans les lacs et tourbières les Desmidiées sont d'excellentes indicatrices biogéographiques. Les *Cosmarium* y dominent nettement, tandis que les *Euastrum* et les *Micrasterias* restent fort rares. Une revue rapide des florules des diverses régions arctiques terminent cette intéressante mise au point. Près de 250 références sont citées dans la bibliographie. — P. By.

DELAY C. et CARPENTIER S. — Action de la colchicine sur *Chara vulgaris* L. I. Action sur les filaments spermatogènes (*Rev. Cytol. Biol. végét.*, 16 (3-4), pp. 416-467, 1953).

Les filaments spermatogènes de *Chara vulgaris* L. ($n = 28$) sont traités par une solution à concentration variée de colchicine. La concentration de 0,04 % correspond au seuil d'action mitoclasique sur les filaments en croissance. On obtient une action fort nette qui conduit à des mitoses anormales, avec souvent un haut degré de polyploïdie (jusqu'à 32 n). Les auteurs s'attachent d'abord à la formation normale des filaments spermatogènes, puis font agir la solution de colchicine, et dans certaines expériences, remettent ensuite le filament traité dans le milieu naturel. Cela leur permet de suivre l'action du poison. On remarque que les troubles mitoclasiques diminuent d'intensité avec le temps : il y aurait donc une sorte d'adaptation.

Les spermatozoïdes diploïdes ou polyploïdes obtenus sont étudiés avec soin : les formes aberrantes, quoique viables, sont souvent à 4 flagelles. L'action de la colchicine sur l'appareil végétatif fera l'objet d'un prochain mémoire. Six tableaux, 7 figures, dans le texte et 16 planches hors texte illustrent et complètent le texte de cet important mémoire.

P. By.

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Le Gérant : R. LAMI. — IMP. MONNOYER, LE MANS.